SCIENTIFIC AMERICAN

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Vol. LXXXVII.—No. 23.
ESTABLISHED 1845.

NEW YORK, DECEMBER 6, 1902.

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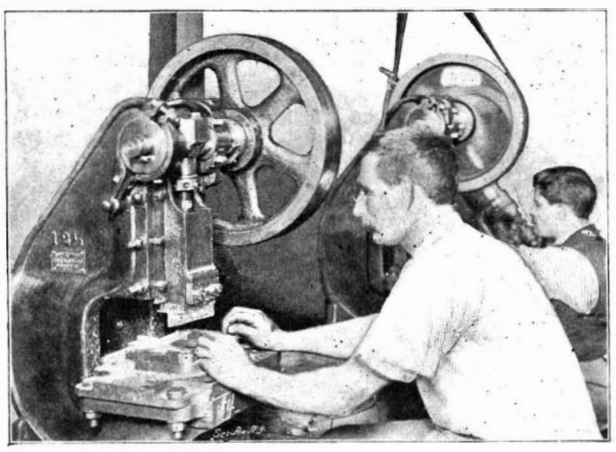
Paring off the Seams from a Doll's Leg.



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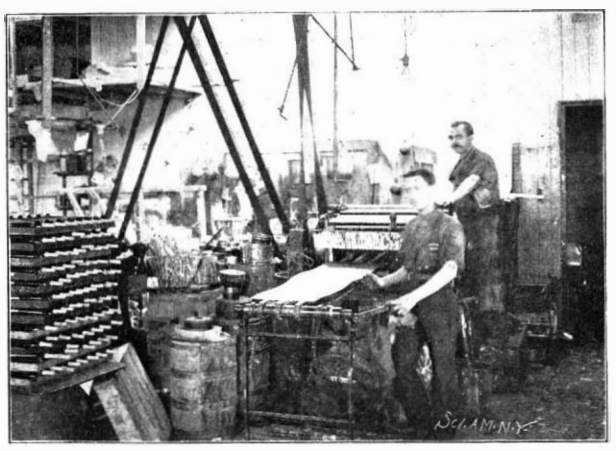


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Painting in the Eyebrows of a Doll.



The Painting-Machine.



Painting the Kitchens.



The Completed Product.

Painting Toy Cars.

THE MANUFACTURE OF TOYS AND DOLLS.—[See page 376.]

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ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
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THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845)..... $3.00 a year
Scientific American Supplement (Established 1876)..... 5.00 "
Scientific American Building Monthly (Established 1885)..... 2.50 "
Scientific American Export Edition (Established 1878)..... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, DECEMBER 6, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE PENNSYLVANIA RAILROAD TUNNEL.

The attitude of the Board of Aldermen of this city in holding up the franchise for the construction of the Pennsylvania Railroad tunnel beneath Manhattan is one of the most shamefaced exhibitions of political tyranny that ever disgraced the city of New York. Here is a great corporation which offers to remove the insular disadvantages under which this city labors, owing to its being cut off by the Hudson River from direct railroad communication with the West, by building, entirely at its own expense and at a cost of something like $50,000,000, a vast engineering work on which, for many years to come, it cannot hope to realize a penny of interest. The tunnel will be built at such a depth below the street grade that there will be practically no interference with traffic, and but very little surface indication that such a vast excavation is being made. From the point of view of transportation the gain to New York city will be simply enormous; and as to the question of rental, there have not been wanting many prominent citizens, and especially those who understand transportation problems, who have declared that the charging of any rental whatever to a company that is voluntarily providing such a beneficial scheme to the city, is altogether unwarranted. The ultimatum which has been presented by the lawyers of the Pennsylvania Railroad Company, stating that if further opposition develops they will drop the scheme altogether, is perfectly natural. While we should greatly regret to see the threat carried through, its execution would be a logical outcome of the exasperating and disgraceful tactics employed by the Board of Aldermen.

TEST OF THE MAXIMUM CAPACITY OF THE NIAGARA FALLS TUNNEL.

In order to ascertain beyond any question of doubt the tailrace capacity of its tunnel, a most interesting test was recently made by the Niagara Falls Power Company. This tunnel is 7,436½ feet long, 21 feet high and 18 feet 10 inches wide. When ground was broken for it, the idea prevailed that it would not have to be lined, but later it was found that a portion of the rock through which it was constructed was so soft that it might possibly be worn by the rushing water. For this reason and in order to make it perfectly substantial, the tunnel was lined from end to end with four courses of brick. In the rough, the tunnel was to have had a capacity of 120,000 horse power; but the lining lessened its capacity, so that it has always been rated at 100,000 horse power.

While not doubting the correctness of the calculations of the eminent engineers who had to do with the tunnel construction, the opportunity presented itself on November 19 for testing the tunnel by sending through it an amount of water equal to the quantity that would be used by the perfected installations in the development of 100,000 horse power. By making a test the Power Company would know by actual practice what up to that time had been theory. While the first six units in the new station will probably be in operation within the next three months, the complete installation will not be in service until the latter part of next year, so by its test of the date referred to the Power Company now knows under just what conditions its tunnel will operate when the flow of all the turbines is passing through it.

The quantity of water sent through the tunnel on the occasion of the test was twice as great as many notable rivers carry. Still, it was only a very small fraction of the water that comes down the upper Niagara from Lake Erie. Observations showed that its diversion was not noticeable on the brink of the cataract, the beauty of which was unimpaired. The test began at 10 A. M. and lasted until 5 P. M., giving ample opportunity to observe the effect on the river, the currents and falls, also the conditions existing in the wheelpits and tunnel.

The discharge at the portal of the tunnel was a most interesting spectacle. The stream from the tunnel extended clear across the river to the Canadian shore, and it was noted that a portion of the surface current passed upstream and a portion of it downstream. Between the top of the arch and the rushing water at the portal considerable space was shown, the entire semicircular arch remaining above water. The test was announced as a success in every particular.

Those who observed the test were of the conviction that one result from the discharge from the tunnel, when 100,000 horse power is being developed, will be that the flow of water will serve to hold back the ice that comes over the falls from Lake Erie, and aid in forming ice bridges of far greater magnitude than have been witnessed at Niagara at any time in the past. If this proves true, no doubt many interesting ice conditions will be seen in the Niagara gorge.

THE GUN IN NAVAL WARFARE.

We have heard so much of late years about the wonderful efficiency of the modern breech-loading rifle, that one feels something of a shock of surprise to learn from the lips of a Lieutenant-Commander of the United States Navy that in future wars it will be only pure good luck that one ship will sink another by the power of her gun-fire. The late annual gathering of the Society of Naval Architects and Marine Engineers was marked by one or two rather startling papers, among which one on "The Tactics of the Gun," by Lieutenant Commander A. P. Niblack must be reckoned. The writer defined a battleship as being, when reduced to its simplest terms, a floating gun-platform. Considered as a unit of defense it contained, on a given displacement, the maximum of concentrated destructive power, first for giving battle on the high seas, and secondly, for attack on an enemy's coastline. The author of the paper believes that if ships are to be sunk it will be done by the ram or torpedo, whose special province it is to penetrate the underwater body of a ship, destroying its watertight subdivisions, and by letting the water into the "vitals"—engine or boiler rooms, or magazines—either putting it out of action, or sinking it altogether. On the other hand, the province of the gun is to deal with the above-water portion of the ship, putting out of action the guns, gun mounts, ammunition hoists, etc., and destroying the officers and gun crews. It is argued that as long as the motive power and steering gear of a warship and such personnel as is not engaged at the battery are intact, it is almost impossible for the guns alone to destroy the vessel. When Mr. Niblack says, "It is only by luck or by indirection that a modern battleship can sink another by gun-fire alone," it is evident that he has in mind the results shown by the examination of the Spanish vessels which have been raised since the battle of Manila Bay, and also the results of gun-fire as shown on the ships sunk at Santiago. "We need not," he says, "in the future expect to set ships on fire by gun-fire as at Santiago and Manila, and, indeed, we have a long way to go before we can expect to achieve victories over our next adversary." Of course, it is well understood that the great destruction of the Spanish fleets was due to fire started by bursting shells, and in what he says above, the writer has in mind the fact that modern warships carry practically no combustible material in the way of inflammable decks, bulkheads and fittings. Hence, we cannot expect, should we engage in another naval war, to see the enemy's vessels burning up before our very eyes after the first fifteen minutes of an engagement. The present situation as regards the tactics of gun-fire is stated succinctly as follows: Bow-fire has become a great factor in modifying tactics. The ram is more than ever a dangerous weapon. Armor has almost nullified the great danger from raking fire at close quarters. The torpedo has made it dangerous to fight at closer range than 1,000 yards. Smokeless powder and high speed make the windward position of little importance compared with getting the sunlight on the enemy and in his eyes. Elaborate subdivisions in ships tend to prolong the time and increase the difficulties of the destruction of a ship by any weapon.

Gun-fire, then, being concerned mainly with the destruction of batteries and personnel, the author of the paper goes on to show that the public does not realize the horrible destructiveness of modern gun-fire. What our fleet accomplished at Santiago was done with only four hits out of every one hundred shots fired; yet since that day, "both ordnance and gunnery have been almost revolutionized, and methods good enough for 1898 are an invitation to-day to disastrous and bitter defeat." To illustrate how gunnery has improved in the past three or four years, and how terrific must be the hail of projectiles in a future engagement, Lieutenant Commander Niblack instances the progress made since the war in the British Navy in the matter of target practice, and he quotes official records of the annual prize-firing contest for last year. A target 20 feet long and 16 feet high was anchored at a distance of about one mile from the course followed by the contesting ships, each of which steamed by the target at a speed of 12 knots and fired for two minutes with each 6-inch gun, firing one gun at a time. According to the official reports, the average of forty-eight ships was nearly two hits per gun per minute. The best fifteen ships made from two to four hits per gun per minute. This means that eighty-two 6-inch guns fired eight hundred and sixty-seven projectiles in two minutes and made 518 hits, or nearly sixty per cent. The battleship "Ocean" averaged nearly five hits a minute, while one of her gun captains fired nine shots and made nine hits in one minute. This, Lieutenant Commander Niblack states, is easily the world's record, as it means less than seven seconds between aimed shots. One gun in particular fired seventeen shots in two minutes and made fifteen hits.

"Just now," says the author of the paper, "the navy needs unusual and heavy expenditures for ordnance." This somewhat pessimistic view of the condition of our navy may seem puzzling in view of the abstract of the report of the Bureau of Ordnance given in our last issue, in which it was shown that our new guns are fully the equal of any that have been built abroad. Mr. Niblack, however, is referring to the number of ships of our navy that are carrying the older types of weapons, shells and powder, which, although excellent in their day, have become outclassed by modern material. He says that owing to the pressure of the past five years, some of our ships have been in continuous service for that period, and everyone of these needs a thorough overhauling as to battery and ammunition, and particularly as to ammunition, as they have on board a heterogeneous lot of brown powder, smokeless powder and projectiles collected from various sources, most of it for the war with Spain. These are matters that can easily be remedied if Congress will only grant sufficient appropriations to renew these older batteries and replenish the magazines with modern shells and powder. A good beginning has been made in this work, and it should be carried through with regard to every ship on the active list of the navy.

THE DEATH OF FRIEDRICH KRUPP.

The death of Friedrich Alfred Krupp, head of the iron and steel industry of Prussia, removes the most conspicuous citizen of the German Empire and one of the greatest manufacturers of the world. The reputation of his works for fine artillery earned for him the name of the "Cannon King" in Germany.

Friedrich Krupp was born on February 17, 1854, the son of Alfred Krupp, who inherited the works at Essen from his father. The first of the steel-making Krupps began work at Essen with two laborers in 1817. When the late Friedrich Krupp became the head of the firm he found at Essen a well-established business which he developed into a world-wide enterprise. The Krupps will always be remembered as great steel makers and as armorers of the world's fighting forces. That was the work of the "Cannon King."

The Krupp works are vast in extent. The real estate belonging to the firm amounts to 900 acres, of which 150 are covered by buildings. The daily output of the works amounts to about 1,877 tons. The late Herr Krupp had the general management of these gigantic works; but the various branches were placed in the hands of a board of twelve directors, who were responsible to him for all the departments, numbering about one hundred.

Friedrich Krupp was the richest man in Germany. Yet he had been accustomed all his life to toil with both hands and brains.

"From my fourteenth year," he once said, "I had to care like a father for my family during the day added to hard work at the factory. At night I had to study how to overcome the difficulties in the way. During this period I lived on potatoes, bread and coffee and scant portions of meat, and toiled until late in the night. For twenty-five years I struggled thus, until conditions grew a little easier. My last remembrance of that period is the growing danger of total ruin and my endurance, suffering and hard labor to avert the calamity; and I say all this for the encouragement of young men who have nothing, are nothing and want to get something and be somebody."

The Krupps have always been known for the interest they have taken in the welfare of their employes. But the "Cannon King" so far excelled his predecessors in this respect that he was more than once accused of harboring socialistic principles. It was Friedrich Krupp's father who started the system of modern dwellings for workingmen as an experiment. The late Herr Krupp himself appears to have developed them from conviction and in accordance with his ideals. He owned 5,469 dwellings, each being constructed differently to avoid architectural monotony. All the houses have front yards with beds of ornamental gardening. Besides convalescent hospitals and orphanages, Fried-

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rich Krupp maintained a pension fund for his employes, amounting to $4,125,000.

Notwithstanding his vast benevolent interests, he is said to have been an autocrat in the management of his affairs. He was almost unknown by sight to his workmen, and rarely visited the works or even his offices. Unlike his father, he took no interest in the technical side of his business, and yet in fifteen years he more than doubled the fortune which he inherited.

AN AMERICAN PARALLEL TO THE TULIP CRAZE IN HOLLAND.

BY IRVING U. TOWNSEND.

Probably few persons not thoroughly conversant with the history of the silk industry in America, are aware that the tulip mania which raged in Holland nearly three hundred years ago, had its counterpart here two hundred years later.

Five hundred dollars was often paid for a bulb of the Admiral Liefkens or of the Gouda variety, $1,000 to $1,200 for a Viceroy, and $2,000 for a Semper Augustus during the mania. In 1634 the craze became so great that all usual industries were abandoned. A choice bulb sold for $1,900 in cash, two horses, a carriage and a set of harness, representing in all $3,000. Persons frequently invested $50,000 in a few dozen bulbs with which to begin business, mortgaging their houses or giving personal property in exchange. These extraordinary values checked the cultivation of tulips, as the bulbs could be bought and at once sold at a profit to speculators. Finally the real tulip lovers became disgusted and in February, 1637, suddenly placed large quantities of the most valuable varieties upon the market. This produced an immediate and disastrous decline in the price of bulbs. Without a day's warning, thousands found themselves ruined. It was several years before Holland overcame the effects of this strange mania.

Now comes the analogy. James I., who almost insanely hated tobacco, was determined that silk worms should be reared in Virginia, mainly because he thought he could thus destroy the tobacco culture, which he ordered to be abandoned. Some silk was produced and sent to England. The coronation robe of Charles II. was made from such silk. During the next hundred years there occasionally appeared a waistcoat or handkerchief of a Colonial delegate, made from homespun and woven silk, and sometimes grand ladies were arrayed in gowns of native-grown silk. For a time silk culture met with great success in Georgia. In 1759, 10,000 pounds of raw silk were thence exported to England. Connecticut was, however, the center of the industry. The Legislature offered a bounty for planting trees. As late as 1825 the culture of silk was very general there and also flourished in Massachusetts. In Pennsylvania it was undertaken and continued with success until the Revolution.

Silk worms were fed on the white mulberry (*Morus alba*) until 1830, when there appeared the Chinese mulberry or *Morus multicaulis*. Dr. Felix Pascalis made known the remarkably rapid growth and the supposed excellent qualities of the tree, thus opening this Pandora's box whence so many evils escaped. It was predicted that by its culture two crops of silk could be raised annually. It had large, thin, tender leaves; it could be propagated easily by cuttings and cultivated as a shrub; and it was claimed that its leaves formed the most nutritious food for silk worms. Soon all the agricultural literature and the newspapers of the country became surfeited with descriptions of this wonderful tree.

At this very time Congress was considering the subject of silk culture. In 1825 the country had imported silk goods valued at $10,000,000, and had exported breadstuffs worth only $5,000,000. This was considered an alarming state of affairs. Secretary Rush of the Treasury was directed to prepare a manual on the growth and manufacture of silk. This was issued in 1828 and known as the "Rush Letter." Many documents relating to sericulture were published by Congress. A Congressional committee recommended that all public lands be leased gratuitously to those who would undertake the cultivation of the mulberry. A bill barely failed of passage that authorized an expert to instruct the farmers everywhere how to cultivate the *Morus multicaulis*. The Massachusetts Legislature ordered the preparation of a manual on silk culture which was very potent in fomenting the craze. The legislature of nearly every State provided for the payment of liberal bounties for planting mulberry trees and raising cocoons.

Thus it was that a speculative furor, a veritable madness, seized upon all classes of people, and particularly—of all men—upon the shrewd, calculating Yankee. It raged like an epidemic. Not only agriculturists, but doctors of divinity, law and medicine, scholars, tradesmen and mechanics, men and women, old and young, were infected with an insane passion to raise mulberry trees. Every one thought the glorious day was dawning when each farm would be a nursery for the young trees, and every house have its cocooneries and its silk worms yielding two or more crops of cocoons yearly. The farmers' wives and daughters, when not feeding the worms, were to reel the silk which would become as cheap as cotton, every woman having at least a dozen silk dresses. A writer of the day said, "You can scarcely go into a house but you find the inmates engaged in feeding worms."

The large profits anticipated in producing silk were insignificant compared with the fortunes that all expected to make by raising the new mulberry tree. This was planted in close hills or in hedges, it adorned highways, and rarely was a garden or any cultivated spot to be seen without it. In 1834 trees of a season's growth were sold for $3 to $5 a hundred, but they soon sold at $25, $50, $100, $200, and $500 a hundred, and sometimes $7 apiece. There is recorded an instance of two trees of one season's growth, raised by one Elder Sharp in North Windham, Conn., which were sold at auction. The first brought $106, and the second $100. Further sales were then withheld because the bidding was not considered to be sufficiently spirited.

As cuttings with buds or eyes were sufficient for planting, slender switches two feet long sold for $25 a dozen and were declared to be worth $60. In fact, the value of the trees became greater than that of the silk which they could by any possibility produce. They became worth too much to be used for silk culture. When the craze reached its height, but little silk was produced for every one was busy raising the new mulberry tree. The speculation in planting, buying and selling trees withdrew attention from the more legitimate business of raising silk worms. Men expected to make fortunes in a few months buying land and planting mulberry slips, and the silk companies almost without exception sank their capital in this way, many fully equipped mills being closed.

One farmer planted $1,000 worth of trees in ¾ of an acre and sold them the next year for $6,000. Elsewhere the trees upon two acres brought $4,000, those upon fifteen acres brought $32,500, and those upon ten acres brought $38,000. The sales in a single week in Pennsylvania exceeded $300,000, and often the same tree was sold several times at advancing prices. A newspaper of the period said:

"Friday, the 'Alabama' took to Baltimore 22,000 mulberry switches, the value of which at the lowest calculation, based on actual sales throughout the country, cannot be less than $45,000. The number of eyes on these switches is ascertained by carefully counting them, to be 2,254,000, which would be considered cheap at 2 to 2½ cents a piece. The whole was raised on fifteen acres of land that would be considered well sold at $10 an acre in ordinary situations."

In 1839, just before the people came to their senses, a nurseryman sent an agent to France to purchase several millions of young trees. He carried $80,000 in cash as a first payment. When the trees arrived, the inevitable crash had come, and the nurseryman failed for so large an amount that he could never reckon up his indebtedness. His trees were offered in vain at a dollar a hundred for pea brush.

After the crash some large holders sought to unload without loss. They chartered an unseaworthy vessel, loaded her with trees and sent the cargo heavily insured via New Orleans to Indiana. To their great chagrin the vessel reached New Orleans safely and the trees were transferred to river boats at great expense and hurried on to their destination. When finally they arrived no one would take them as a gift.

When the fever was over and the people realized that their capital stock was suddenly worthless, a deep reaction set in. They pulled up all the mulberry trees in a rage and burned them as brushwood. The numerous companies which had invested their capital in them succumbed almost without exception. In 1841 only one survived and that perished four years later. In 1844 a violent storm following a general blight destroyed most of the remaining *Morus multicaulis* trees and even the more hardy white mulberry variety. This was the finishing blow and thus silk culture in America practically ceased to exist. No industry ever, in this country, received such a crushing stroke.

From that day to the present, sericulture has at times been spasmodically undertaken on a small scale in many States, but the total output has been almost infinitesimally small. The Secretary of Agriculture is now endeavoring to revive American sericulture by governmental aid.

RESTORATION OF THE PARTHENON.

Despite foreign criticism Greece is determined to restore the ancient Parthenon. At first the work was to be carried out with old fragments of marble taken from the surrounding earth, but the authorities finally decided that nothing but new, freshly quarried stone should be used. The result will probably be grotesque, for the ancient stone is weather-stained.

The original appearance of the old structure can probably never be restored. It has been quite definitely settled that although the edifice was built of the purest white marble, it was colored here and there. It is likely that the sculpture was also relieved by color and that the moldings were painted or gilded. The Greek government intends completely to restore the building merely so far as its original shape is concerned.

SCIENCE NOTES.

An oxyacetylene blow-pipe is described by M. Fouché in the Bulletin of the French Physical Society. The flame is formed by the combustion of a mixture of one part of acetylene to ¼ of oxygen, and in order that the explosion may not travel back into the blow-pipe, a jet velocity is required, due to the pressure of a water column four meters in height. The flame melts most metals readily; it will solder iron and steel. Even silica and lime are melted by it. With a reduction of the proportion of oxygen, the flame becomes luminous, and on falling on lime the free carbon goes to form carbide of lime.

J. O'Brien contributes a suggestive note to the Gardener's Chronicle, on the differing odor of *Odontoglossum hebraicum* as observed at different periods. When first flowered by the writer the blooms had a marked cinnamon odor, quite distinct from the hawthorn fragrance of other members of the group. On passing into other hands, the plant, when it first flowered, gave off the hawthorn odor but on the next occasion of its blooming the smell was that of cinnamon. The writer does not state if these differences of odor have been traced to diverse periods of the blooming. It has been noticed by those who grow the common jasmin that the flowers, when first expanded, possess in a marked degree the delicious fresh odor which is characteristic of them. But as flowering progresses, the perfume becomes less delicate, and the blooms are then very attractive to blue-bottle flies. This would appear to have some connection with the recorded formation of indol in the jasmin bloom as the process of flowering approaches completion.

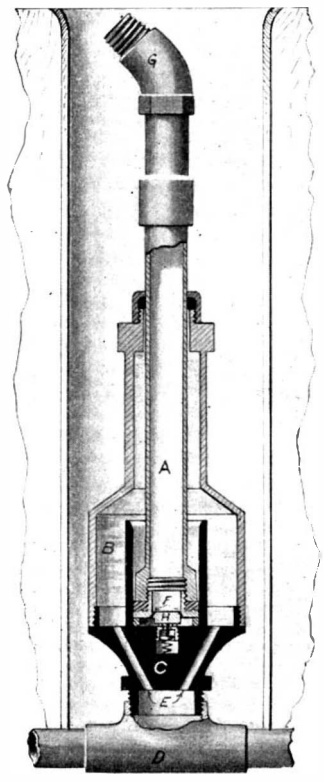
Mr. J. Halm, of the Royal Observatory of Edinburgh, has proposed a new and more complete theory of the sun, briefly as follows: Previous theories of the periodic changes have taken no account of the absorbing envelope surrounding the photosphere. If the loss of energy by radiation exceed the production of heat due to shrinkage, the temperature must fall. The level of the layer of maximum radiation, i. e., of the photosphere, must shift toward the center, and consequently the photosphere becomes protected by a greater thickness of absorbing and reflecting matter. After a time the increasing reflection may overheat the photosphere, but the overheated material may be retained at the level of the photosphere by convection currents until the upward tendency becomes so strong as to produce an eruption by which thermal equilibrium is temporarily restored, after which the cycle is repeated. The mathematical expression of the theory gives an equation from which a curve of sun spots may be computed which agrees very closely with the results of observation, while a "great period" of solar phenomena is accounted for by changes in the intensity of the convection currents, the equation showing that when the spot development is powerful the rise from minimum to maximum will be accelerated. A remarkable conclusion from the theory is that times of maximum spottedness correspond to times of minimum radiation, which would seem to be supported by the more important recent researches.

At the recent International Aeronautical Congress at Berlin Prof. Dr. Assmann, Director of the Aeronautical Observatory of the Prussian Meteorological Institute, described his registration balloon of caoutchouc or Para rubber, which was one of the novelties of the meeting. The ordinary *ballon-sonde*, made of silk or paper and open at the bottom, has the great disadvantage that, when it approaches equilibrium in the upper strata of the atmosphere, its velocity of ascent decreases and the effect of insolation on the thermograph becomes greater, without it being possible to determine afterward the place where the solar disturbance began during the ascent or where it disappeared during the descent; in fact, it is only in certain cases that we can distinguish between the insolation influence and the curious thermal anomalies that have been described by Teisserenc de Bort and Hergesell. The use of a closed balloon made of elastic material has this advantage, that in proportion as the inclosed gas expands, the ascensional force is increased so that the balloon rises faster with augmenting height until it bursts and then falls to the ground with diminishing velocity, because checked by a parachute. The time of equilibrium is therefore reduced to an instant, and although the higher the altitude the more intense is the solar radiation and its effect on the thermograph, yet the speed of ascent and descent is also increased and, consequently, the ventilation, which counteracts the radiation, is likewise stronger. The least possible weight of balloon envelope and of registering apparatus is required, for the lighter the whole apparatus, the less gas is needed, and the smaller the quantity of gas the more it can expand before the envelope bursts at a proportionally greater height.

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NON-FREEZING HYDRANT.

A hydrant embodying a number of important improvements is described in a patent recently granted to Mr. Charles L. Burkhart, of Dayton, Wash. The hydrant is provided with a tubular piston, which may be raised to permit the water to flow, and when lowered will stop this flow, at the same time opening a valve to drain out the water in the piston, thus rendering the hydrant non-freezing. The entire device is situated in a casing which is sunk into the ground. The tubular piston, which is marked *A* in our illustration, projects from the hydrant proper. The hydrant proper consists of two sections, *B* and *C*, which are screwed together and form a chamber. Section *B* has formed on its upper end a nut, above which is a packing fitted snugly against the piston, *A*. The section, *C*, is connected with the water-supply pipe, *D*. Two channels, *E*, lead up through the section, *C*, to the hydrant chamber. Projecting upward from the section, *C*, is a cylinder formed thereon, into which the lower end or head of the piston, *A*, rests when the hydrant is not in use. The piston head is provided with a rubber gasket, which snugly fits against the walls of this cylinder. The gasket is held in place by a cap piece, *H*. When in its lowest position the cap piece depresses the stem of a valve in section *C*, opening the valve and permitting all water in the piston to be drained out through an outlet channel. With the parts in the position illustrated, the pressure of the water in the hydrant chamber acts on the piston to hold the same in its lowest position. If it is desired to use the hydrant, the piston is raised until the piston head clears the top of the cylinder. The drainage valve then closes, and the water passes up through the openings in the cap piece, *H*, and out through the tubular piston. A hose may be connected to the elbow, *G*, and since the piston is revoluble, it will follow the movement of the hose, preventing kinking of the hose and consequent interruption in the flow of water. Since the piston must be lowered in order to cut off the flow of water, it normally assumes a position which will not interfere with a lawn mower. If it be desired to remove the hydrant from connection with the water supply without injuring the casing, it is simply necessary to remove the elbow, *G*, and slip a suitable tool down over the piston to an engagement with the nut on the upper portion of the section, *B*, and upon turning this the hydrant will be unscrewed from the coupling *D*.



NON-FREEZING HYDRANT.

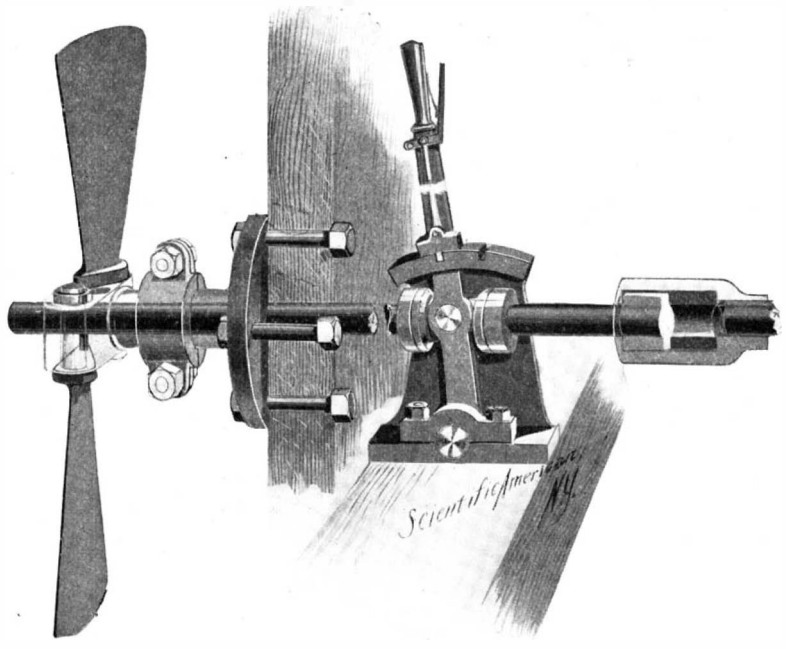
A few weeks ago the last train over the "baby gage"—a 22-inch railroad—was run from Longfellow to Metcalf, Ariz. Acording to the Copper Era, a new 36-inch narrow-gage road takes the place of the old. The "baby gage" was built in the early seventies. It was the first railroad ever built in Arizona. The engine was hauled overland from Sargent, Kans., then the nearest railroad station, to Clifton and set up by Dad Arbuckle, who is still in the employ of the company. At first the road was built and operated only to the Longfellow mine, but was afterward extended to Metcalf. The old "baby gage" was considered quite an engineering feat in its time, and justly, too, because it was built at a distance of more than one thousand miles from the nearest railroad points.

REVERSIBLE SCREW-PROPELLER.

The accompanying engraving illustrates a screw-propeller of a construction which enables it to be reversed by a sliding movement of the propeller shaft. It does not require the use of a hollow or tubular shaft usually employed, and therefore requires the use of only one stuffing box and other features incident to the two shafts. Further, it enables several reversible propellers to be mounted in tandem on the same shaft, thus securing great efficiency and at the same time preserving the advantage of reversible propellers.

The propeller shaft is connected at its inner end to the engine shaft by a coupling which allows longitudinal sliding movement. At its opposite end the propeller shaft passes through a box secured to the sternpost of the vessel. The propeller blades are carried on a hub mounted on the outer end of the propeller shaft. This hub is held against sliding movement with the shaft by a coupling which connects it with the box on the sternpost. This coupling, however, is of such design as to permit free rotary motion of the hub. Each blade of the propeller is provided with a crank-shaped base which is rockably mounted at one end on the hub, and at the other is held in place by a pin driven into the proper shaft and extending through slots formed in opposite sides of the hub. At a convenient point in the vessel a hand lever is mounted, which is suitably connected to the propeller shaft and may be actuated to slide the same longitudinally. Our illustration shows this shaft in its outer position. By drawing the shaft inwardly the propeller blades will be reversed, their crank-shaped bases, by reason of their connection with the pin on the propeller shaft, being swung on the pivot pins, which secure them to the hub.

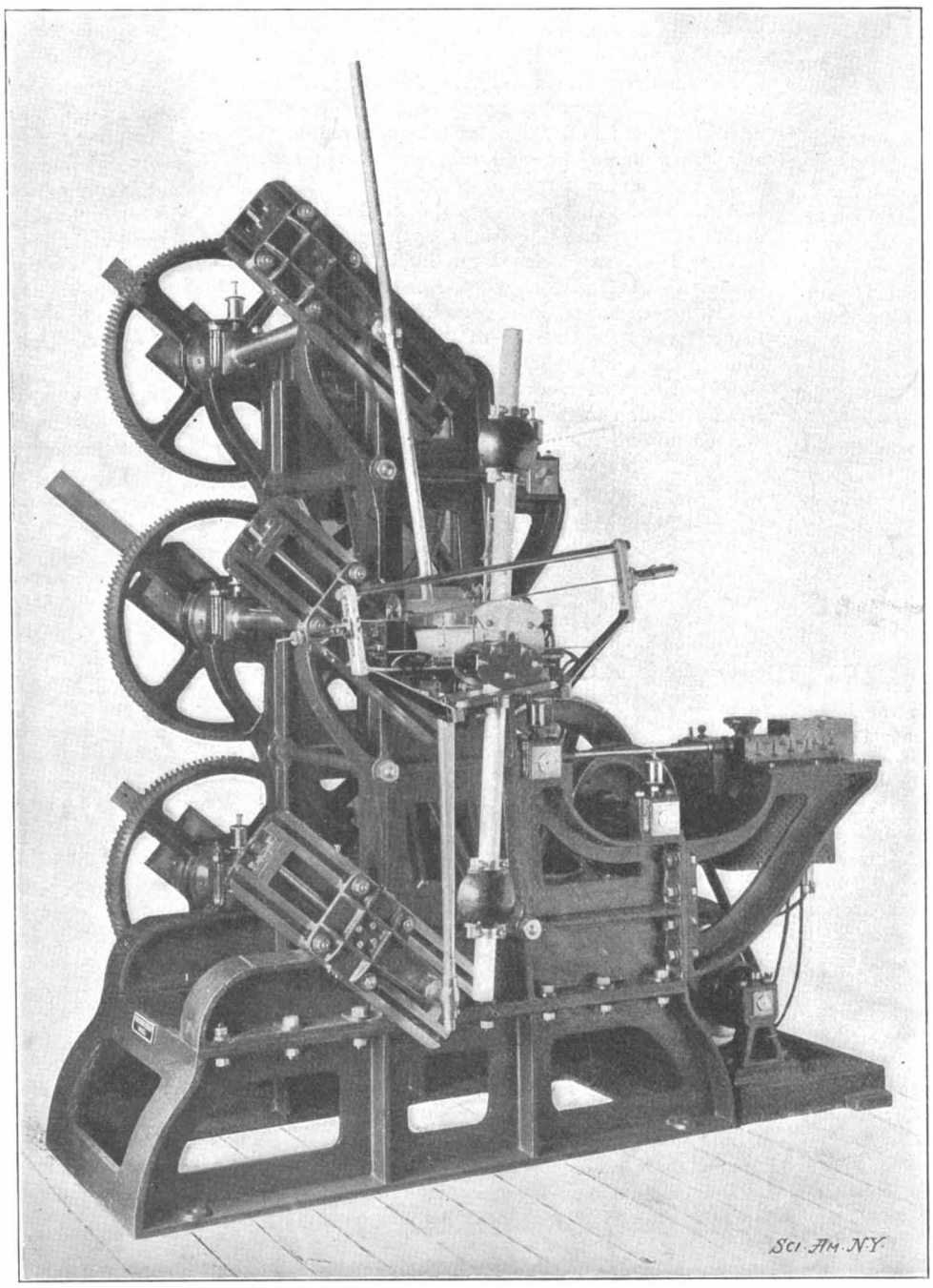
This invention will be found applicable particularly to small vessels, although of course it may be used on larger craft if desired. A patent on the device has recently been secured by Mr. Samuel Irwin, of Lindsay, Ontario, Canada.



REVERSIBLE SCREW-PROPELLER.

THE NAVIPENDULUM METHOD OF EXPERIMENT.

The movements of a ship in a body of still water are not unlike those of a pendulum, the ship, if it be moved from the perpendicular, beginning to oscillate around the vertical and coming to a state of rest after having gone through a series of oscillations of gradually decreasing amplitude. We present an illustration of an invention by Capt. Russo, of the Royal Italian Navy, which was designed to enable us to solve the problem of the rolling of ships. It will be seen that the apparatus contains a kind of pendulum which is composed of a heavy rod and two weights, one near each end. The pendulum rests and rocks through a central block upon a plate. The rocking motion of the pendulum is analogous to that of a rocking-chair or a small rocking-horse, to which the rolling motion of a ship may be roughly compared. In constructing a navipendulum, it is necessary to know certain data regarding the ship to be experimented upon, such as the displacement, form of hull, distribution of weights, metacentric height, the curve of stability, the period of oscillation, the amount of still-water oscillation, etc. All of these elements are involved, so that the instrument, if properly constructed, becomes an exact representative of the ship itself in everything that affects its rolling in still water. If the working of the navipendulum were confined, however, to still-water experiments, it would have but small practical value, as the beautiful tank experiments of the late Mr. Froude have given us all data on this subject. But the usefulness of the navipendulum begins where the tank leaves off, namely, in solving the important problem of the rolling of a ship on waves. After comparing the rolling of the ship in still water to the motion of a rocking-chair on a fixed plane, it is only necessary, in carrying the parallel further, to suppose that the sustaining plane, instead of remaining at rest, be made to oscillate, inclining and displacing itself from one side to the other in a forward and aft direction, and also in a vertical direction. The rocking-chair in this case, while following the plane of the various displacements, will, of course, have a more complicated movement than when the plane is at rest; it will incline from the vertical by angles of variable amplitude to the right and to the left. The oscillatory motion of the chair will, in such a case, be similar to the rolling of ships on waves, since it happens that the element on which the ship is supported continually changes in trim and position to the position of

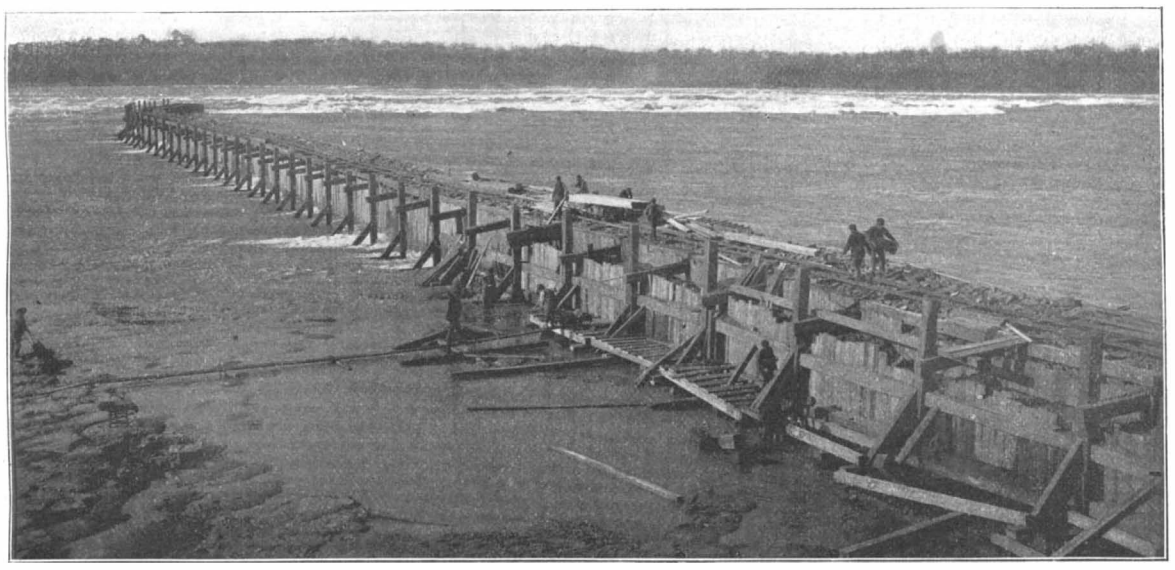


THE NAVIPENDULUM FOR DETERMINING THE STABILITY OF A SHIP AS AFFECTED BY WAVES.

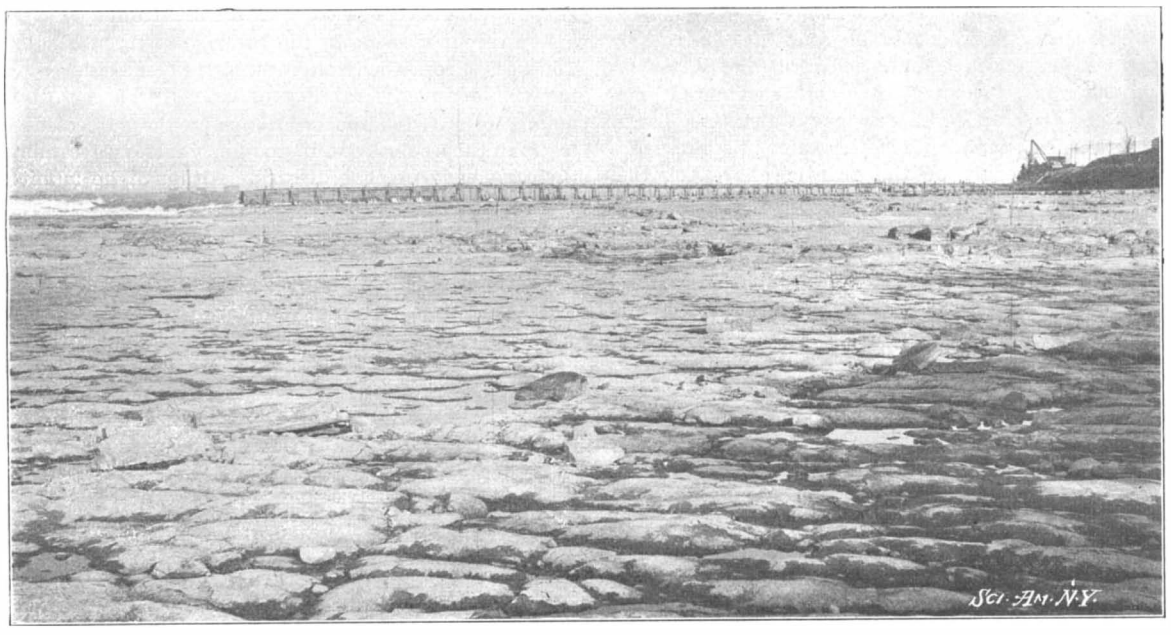
The bar with weights at each end rocks, by means of the rocker, at its center, on a plate, which changes its inclination in imitation of the changing inclination of the waves.

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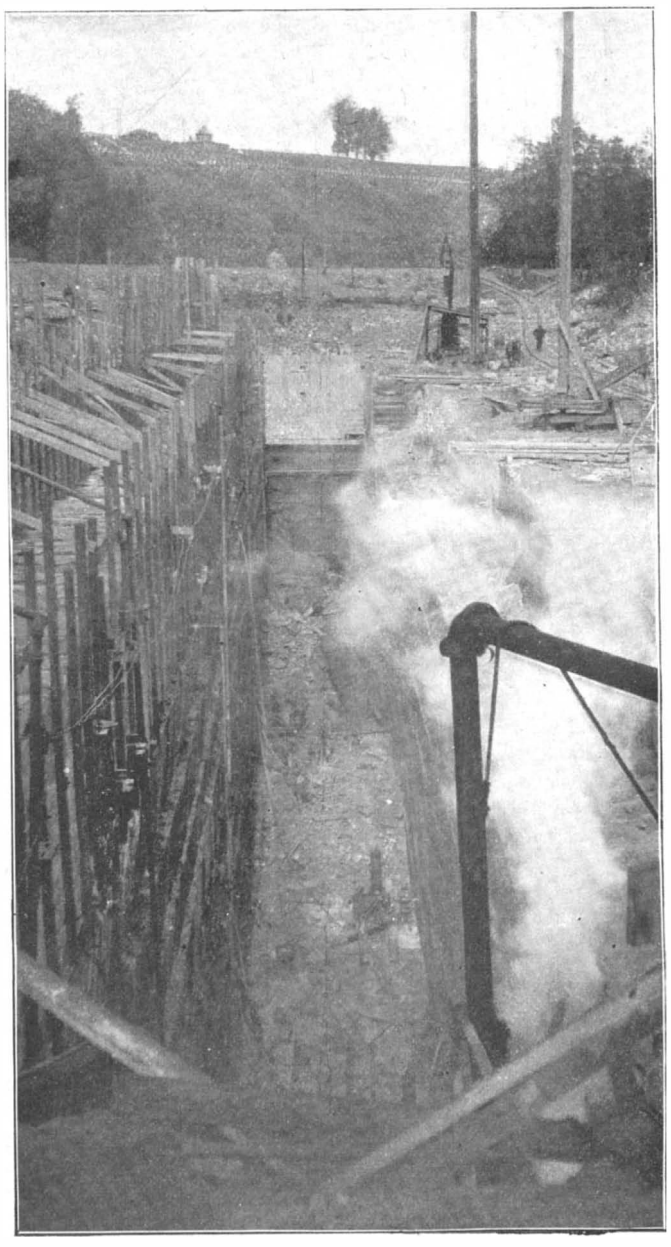
successive waves. While the above is but a rough comparison, the scientific process followed in Capt. Russo's method has led to the construction of an apparatus, in which it is claimed that a perfect similitude is established between the case of the ship in the waves of the sea and that of the navipendulum carried by the apparatus which we herewith illustrate. The whole object of the various axles, gears, electric motor, etc., is to give to the plate on which the navipendulum rolls a complex motion of a special nature, which is determined on the basis of the length, height and period of the wave constructed in the experiment. The navipendulum enables the naval architect to ascertain in the designing of a ship, the degree of steadiness which she will actually possess. Its importance in this respect may be judged from the fact that many ships have been found after construction to be wanting in a proper margin of stability. With the navipendulum to guide him the naval architect would never make any mistake on this question of stability. The apparatus described has been officially adopted by the Italian Admiralty, who have provided their experimental works at Spezia with an instrument of this kind.



OUTER END OF BIG WING DAM ABOVE THE DUFFERIN ISLANDS.



A LARGE SECTION OF BED OF NIAGARA RIVER ABOVE THE HORSESHOE FALL LAID BARE BY CONSTRUCTION OF DAM.



WHEELPIT OF THE CANADIAN NIAGARA POWER COMPANY.

THE NEW PLANT OF THE CANADIAN NIAGARA FALLS COMPANY.

BY ORRIN E. DUNLAP.

The Canadian Niagara Power Company is making good progress with its work on the Canadian side at Niagara Falls, and the time is fast approaching when this installation that is destined to command much attention will be completed. This company is practically the Niagara Falls Power Company, and the plan it has adopted for the development of power on the Canadian side is very similar to that so successfully established on the New York side, where a tunnel 7,436½ feet long and two wheelpits, one 424 feet long and the other 463 feet long, have been built.

On the Canadian side the scene of the power development is in Victoria Free Park, a section of territory purchased by the government for park purposes, in order that the beauty of the falls of Niagara might be preserved from vandalism and the works of man. Promoters of the industrial interests of the locality have, however, found that the park is an ideal site for a great power development, and the ideas thus developed are now being carried out in their fullest detail. The Canadian Niagara Power Company will develop power by means of a wheelpit and tunnel tailrace. The length of the wheelpit when completed will be 480 feet, but a section 266 feet in length is now being built. This pit will be 21 feet wide and 170 feet deep. It has reached a depth of about 115 feet at present. The method of construction, and the rock through which it is being sunk, are almost identical with that of the two pits on the New York side.

When completed the wheelpit will be lined with brick from top to bottom. The first section now building will afford a development of 50,000 horse power through the installation of five units of 10,000 horse power each. The contract for three of these has been awarded to Messrs. Escher, Wyss & Co., of Zurich, Switzerland, none of the shops in the Dominion of Canada having facilities for their construction. It is understood that they will be somewhat similar to the turbines installed by the Niagara Falls Power Company in wheelpit No. 2, but each of just twice the output capacity. The turbines just ordered are to be delivered within a year, and the first power from the installation is expected to be ready for delivery early in the spring of 1904.

The generators to be installed in the power station of the Canadian Niagara Power Company will also be of 10,000 horse power, or of twice the capacity of the generators in the two stations of the Niagara Falls Power Company. They will be wound for 12,000 volts, three-phase. The frequency will be 25 cycles, which will give uniformity with the plants on the New York side and allow of parallel operation. A generator that has an output capacity of 10,000 horse power will occupy but little additional space to a generator of 5,000 horse power, and while saving in space, the Canadian Niagara Power Company also secures a lower cost of generator per horse power and a lower cost of turbines per horse power. The speed of the generators will be 250 revolutions per minute. A feature of the development on the Canadain side is the fact that as the power plant will be located in Victoria Park, all of the power produced must, under the agreement with the commissioners, be transmitted beyond the park boundaries for use. Under these circumstances the voltage of 12,000 is expected to result in economy, and for long-distance transmission the voltage will be increased to 40,000 or 60,000. The power plants on the New York side will be connected with the Canadian plant by means of three cables strung across the upper steel arch bridge.

In connection with the development on the Canadian side the Canadian Niagara Power Company is constructing a large forebay. This will extend the full length of the wheelpit, but at a point where it will be bridged it will narrow down to 250 feet, passing which point it will again broaden out to 400 feet or more. The forebay will carry an average depth of 18 feet of water. From the north end of the wheelpit a canal 16 feet wide will be built for 500 feet to the river, affording facilities for an ice run. The flow in this canal will be regulated by gates. The bridge that will span the forebay will be of the stone arch type, built in five arches. It will have a width of 60 feet and will carry the tracks of the Niagara Falls Park and River Railway as well as a boulevard driveway. When finished the bridge will be one of the prettiest in the Niagara region.

The tunnel that will connect the wheelpit with the lower river will discharge very close to the foot of the Horseshoe Fall. It is 2,200 feet long, not a third of the length of the tunnel on the New York side. However, it is 25 feet high, which is four feet higher than the New York tunnel, and its width will be 18 feet. The tunnel has been driven, and the contractor, Anthony C. Douglass, is now removing the bottom bench, having taken out about 1,200 feet of it, or more than half. Owing to the great scarcity of brick, in lining this tunnel concrete is being used from the spring line down, but the concrete lining will have a facing of vitrified brick. This application of concrete will do away with 3,000,000 brick, but 1,250,000 brick will be used in forming the arch. Owing to the closeness of the portal to the Horseshoe, the masonry to be built there will be massive. As it is located at a point where ice gathers in immense quantities in the winter time, it will be subjected to great stress. This work will not be begun until next spring, owing to the nearness of the winter season. At the portal about 60 carloads of granite from Quebec and 200 carloads from Queenston will be used. In timbering the tunnel over 2,000,000 feet of lumber was used.

A SECOND GREAT POWER PROJECT.

The Ontario Power Company is also working on its project for the development of power in Victoria Park. This company's plan is to develop power on somewhat the same principle as that in use by the

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Niagara Falls Hydraulic Power and Manufacturing Company on the New York side. This latter company, however, carries its water to the edge of the high bank of the gorge through a surface canal, whereas the Ontario Power Company will conduct its water supply from the upper river, through the park, in large pipes, but whether they will be of wood or steel is not yet stated. The company will have its power station in the gorge, a short distance below the Horseshoe Fall, where a large force of men has been at work several weeks excavating the debris slope of the bank.

It is the Ontario Power Company that has constructed the immense wing dam out in the river above the Dufferin Islands. This wing dam is nearly 800 feet long, and already it has had the effect of diverting the waters of the river to such an extent, that a large area of the river bed between the dam and the Falls has been laid bare. The depth of water over this portion of the river was always inconsiderable, and the interference with the current by the dam easily produced the large area of dry river bottom shown in the accompanying photograph. It is interesting to note the curiously rounded appearance of the rocks resulting from the age-long attrition of the rushing waters.

THE MANUFACTURE OF TOYS AND DOLLS.

In a quarter of New York's "East Side," imbued with the half-European, half-American atmosphere so characteristic of Bohemian, Hungarian, and Polish settlements in America, a toy factory is situated which furnishes the children of our Eastern States with cheap, gayly-colored playthings. The factory, industrially considered, is a picturesque combination of modern labor-saving and old-fashioned labor-employing methods; for the most ingenious machinery and the simplest form of hand labor work side by side. There are some things that machinery can never do; and for that reason the factory girl cannot be dispensed with —in a toy-factory at least.

Historically considered, the toy industry may be said to have begun in Nuremberg. The development of the industry that made the old town so famous may be easily traced in the collections of the Germanic Museum. There completely furnished doll-houses, with cellars, vestibules, staircases, servants' quarters and drawing-rooms, are set up, and faithfully represent the home life of olden times. The old mechanical toys which are here to be seen are the work of locksmiths; for besides working at his trade the Nuremberg locksmith made many a clever toy. Tinkers opened a new field for the toy industry by the introduction of optical instruments, such as magic lanterns, and of magnetic toys, ships and swimming animals. The use of steam power and later of electricity gave the industry another impulse.

From roof to cellar the interior of the New York factory referred to is a chaos of flaring color. Paint—red paint, green paint, yellow paint, paint of all possible hues—is spread with lavish hand on the tin. The factory girls are besmeared with it; every floor reeks with it.

The tin used in making the toys is purchased in large sheets. By treadle-operated shearing machines fitted with reciprocating-knives the sheets are cut into strips or pieces of various sizes and shapes. Some of the sheets are embossed with designs, and are then passed through the paint-covered rollers of a painting machine, by which the embossed surface is coated and the intaglio left in its original bright metallic condition. These embossed and colored sheets are variously utilized in the making of kitchens, seashore-sand pails for boys and girls, shovels, comb cases and the like.

From the shearing-floor the cut sheets are taken to another floor to be stamped into various forms or "pressed," as it is technically called. The presses used comprise each a substantial frame with a horizontally mounted shaft connected by a crank with a plunger carrying a die. With but a single downward movement of the plunger a piece of metal is given any desired shape. Kitchen utensils such as cups, saucers, plates, dishes and the thousand and one articles that are made in a toy-factory are stamped out by these machines. Many of the products are taken to another room and turned in order to remove the jagged edges.

Besides the presses peculiar forming-machines are used which are of exceedingly simple construction, and which serve the purpose of forming tin tubes from long strips of metal, and of crimping the edges of various utensils. The tube-forming machines consist primarily of a table having a semi-cylindrical groove, and of a plunger carrying a die the length of the semi-cylindrical tube. By dextrously manipulating a long strip of tin, an operator causes the die to force the strip into the groove, in order to form a perfect cylindrical tube.

After the various articles have been made by the presses and forming machines, they must be painted. For that purpose they are turned over to girls who apply the color by brush. No machine could possibly perform this work; for the girl must know exactly where the color is to be applied and how to apply it. Almost every toy that is made must eventually pass through the hands of the painters. Railway cars are striped, kitchens are ornamented, horns are encircled with bright bands, and horses are given colored coats and furnished with painted harnesses. The painted toys are dried in a special steam-heated room.

Many of the toys either before or after they have been painted are turned over to men whose duty it is to rivet in their places parts which cannot be applied by machinery. Railway cars, for example, must be furnished with wheels. Certain workmen are therefore supplied with miniature axles upon which a single wheel is rigidly secured at one end. The axle is clamped in a vise; the car bearings are slipped over the axle, and the remaining wheel placed in position and riveted with a few taps of the hammer. Similarly, horns must be furnished with sound-producing means. For that purpose solderers are employed, who are furnished with small brass reeds, which are leaded in place at the mouth-end of the horn and covered with wooden mouthpieces. The horns after having been equipped with their reeds are tested. If the reed has been improperly applied, the error is corrected. Some of the toys, as for example human figures, must be dressed, and are therefore passed to girls, who sew the garments on the tin bodies.

Mechanical toys, which, at one time, were almost exclusively made in Germany, are also produced in this New York factory, though in limited quantities, to be sure. Many of these toys are ingenious pieces of mechanism and comprise interesting mechanical movements. Without exception the mechanical toys are all driven by clock-trains, the escapement of which is so mounted as to produce the peculiar effect desired. By an ingenious arrangement of the escapement and the clock-train, miniature drunkards are produced, with reeling walk, maudlin nodding head, and absurdly moving arms, which simulate an attempt to fill a glass held in the one hand from a bottle held in the other. A fiddler who industrially saws away, without, however, producing any sounds, is another interesting mechanical toy. But perhaps the funniest of all these mechanical playthings is the so-called "balking mule," which represents a clown seated in a cart drawn by a rather refractory mule whom he seeks to control by rocking himself forward and backward, and violently jerking the reins. The toy is so constructed that the mule gallops forward for a few paces and then backward with equal rapidity for the same distance—all apparently the result of the frantic efforts of the clown to stop him.

In another New York factory situated in the heart of the business district, dolls are made; not China dolls, but dolls that can be dropped upon the floor without breaking. The process of manufacture on the whole is decidedly simpler than that of making metallic toys. The steps are few and simple. A peculiar composition is poured hot into a mold to form the head, arms, or feet. After the portion thus cast has cooled, it is removed from the mold and passed on to workmen, who pare off the seams and jagged edges by means of knives and smooth the surface with sandpaper. The eyes, which are specially imported from Europe, are then inserted through the neck into the sockets. Other operators thereupon paint in the eyebrows and hair and tint the cheeks. The more expensive dolls are provided, not with painted hair, but either with artificial hair of jute or with real hair.

The bodies of the dolls are merely stuffed sacks with extensions upon which the arms and legs can be sewed. After the entire doll has been completed, it is dressed in clothes varying in splendor with the price of the doll.

The Need of a Safe Match—A Chance for Inventors.

At a meeting of about forty manufacturers and dealers, called at the suggestion of the Fire Commissioner of New York, to consider the possibility of finding a match that would be safe to use, it was stated that the safety match is in reality no safer than the parlor match. If this be true, there is not much to be gained by the law prohibiting the sale of parlor matches. There seems to be here a chance for some inventor of a chemical turn of mind to use his ingenuity in designing a match which shall be safer than the matches at present in use, and shall not entail any danger in its manufacture.

Award of the Nobel Prizes.

The Nobel research prize of $40,000 has been awarded to Major Donald Ross, of the Liverpool School of Tropical Medicine, in recognition of his investigations into the mosquito-malaria theory. Three other Nobel prizes were awarded, as follows: Natural science and chemistry, Dr. Emil Fischer of the Berlin University; physics, Dr. Arrhenius of the Stockholm High School; medicine, Dr. Finsen. Each prize is worth 160,000 marks.

Correspondence.

The Effect of Light on Animal and Plant Life.

To the Editor of the Scientific American:

I note with interest a very able article in your last issue, by Dr. James Weir, Jr., in which he describes the effect of light on plant and animal life, with but one probable error, which I shall endeavor to point out. He says among other things:

"Flammarion's beautiful experiments at the climatological station at Juvisy have shown beyond question of doubt the widely different effects of the red and violet rays on plants. The plants chosen were of the genus Mimosa, or "sensitive plant," and were subjected to the same environments with the exception that some were reared beneath dark blue glass, and others beneath red glass.

"In four months the plants grown under the red glass had attained extraordinary development, while those subjected to the violet rays had made no progress whatever. Similar effects were noted in the case of strawberries, and numerous other plants, vines and shrubs.

"The plants grown beneath blue glass did not die, but seemed to remain in a dormant condition, without growth or further development. Zacharawietz, of Vaucluse, has also shown that plants are strongly affected along the lines of rapid growth and development by red and orange rays. As early as 1883 I demonstrated and published the fact that typhoid fever germs would not live when subjected to the blue or violet rays."

From the foregoing one gets the impression that plants under a red glass are subjected to red rays of light, while the reverse must be true, as the red glass has absorbed all the red rays of light, and the remainder only have penetrated.

Who has not observed that in a photographic dark room, where a red light is used, anything therein which is red will appear white, for there are no red rays in the room, all being absorbed by the red paper through which the light is filtered.

E. Ritchison.

Modale, Iowa, November 22, 1902.

Koch's Last Communication.

At a recent meeting of the International Tuberculosis Congress, Prof. Koch reiterated all that he said regarding the non-transferability of animal tuberculosis to man. He asserted that statistics on the subject of intestinal tuberculosis were too incomplete to establish the frequency of that disease. Although he admitted that cases of tuberculosis do occur among butchers and other persons who handle animals, he asserted that the percentage of sufferers from the disease among joiners is equally as high as among handlers of animals and meat. Experts state that large amounts of tuberculous meats are consumed, and that not only the flesh, but even the tuberculous organs are made use of for food, yet no widespread infection follows. Prof. Koch declared that only two cases of alleged general infection were known to him, and that these two were not proved.

Shipment of the 16-inch Rifled Gun.

The 16-inch rifled gun built at Watervliet for the United States Government, has been shipped to Sandy Hook. The railroad companies feared to transmit the 130-ton gun over their roads and refused transportation, by reason of the great strain which it would impose upon their bridges. A New York dredging company made a contract with the company to transfer the weapon from Watervliet down the Hudson River from Troy to Sandy Hook. The price for this service is said to have been $5,400. The gun was placed on a specially-built car and run to the river front. There the gun and car were lifted onto a barge by means of a 250-ton derrick. At Sandy Hook the wharf was strengthened to receive the big gun.

The Current Supplement.

In the current Supplement, No. 1405, the description of the Langley aerodrome is concluded. Certain improvements in methods of quarrying slate are published, which are well illustrated. Francis J. Fitz-Gerald discusses exhaustively the subject of the conversion of amorphous carbon into graphite. An article on long spans for overhead electric cables is a subject which, at a time when the transmission of electrical currents over long distances is being more and more developed, should be read with some little interest. Mr. Kittredge concludes his discussion of the utilization of wastes and by-products in manufactures. Prof. Dr. von Bezold tells much that is interesting of the upper atmosphere. Archæologists will find published for their special benefit an account of the recent discoveries of the Italian mission in Crete, and an article by Eduard Seler on Prehistoric Civilization in America. V. de Turine describes photophonic books for the blind. The usual number of Selected Formulæ, Consular Notes and Trade Notes are also published.

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Exposition of Hygienic Milk Supply.

The U. S. Department of Agriculture has received through the Department of State notice that a general exposition of hygienic milk supply will be held at Hamburg from May 2 to May 10, 1903. The exposition will embrace eight sections as follows:

Section A.—For milk production: (1) Exhibit of limited number of milch cows of known race; (2) stable fittings and implements; (3) regimen and hygienic food; (4) technics of milk, tests, and execution of; (5) management of milk in stable and pastures; (6) personnel of milking and stable (clothing, health and supervision of the same).

Section B.—Veterinary control of the condition of milch cows and of milk: (1) Legislation; (2) management of contagious outbreaks (with demonstration); (3) diseases of milch cows; (4) special diseases; (5) unwholesome food plants and drinking water; (6) secretion through the milk of medicinal stuffs; (7) sanitary management; (8) disinfection of stalls (means and apparatus).

Section C.—Conveyance of milk, land and waterways, railways; conveyance and distribution in cities; (2) cleansing, spinning, cooling, Pasteurizing, sterilizing and concentrating (condensing) milk; (3) arrangements for measuring and weighing; (4) cleansing apparatus for flasks; (5) machinery for bottling, pouring and sealing.

Section D.—Exhibit of management and sale of milk (wholesale and retail trade), with complete furnishings.

Section E.—Milk legislation and administration: (1) Laws, ordinances, decrees and judgments; (2) police supervision of milk traffic (removal, previous examination, preserving, conveyance); (3) chemical and bacteriological inspection; (a) model laboratory, working; (b) instruments and tools for laboratory.

Section F.—Scientific: (1) Means of instruction with scientific demonstration; (2) scientific instruments and tools for milk laboratories; (3) literature, statistic and graphic exhibitions.

Section G.—Milk preparations: (1) Condensed and prepared for long keeping for use in the army and navy; (2) milk for infants; (3) for therapeutic purposes; (4) other foods and preparations produced from milk.

Section H.—Machinery and apparatus for the treatment of milk in the household.

Intending exhibitors should make application for space to the Geschäftstelle in Hamburg, 6, Kamp Strasse 46.

"The Land of Unbounded Possibilities"—A German Economist's View of the United States.

Herr Ludwig Max Goldberger, of Berlin, Royal Privy Councilor of Commerce and Member of the Imperial German Consultative Board for Commercial Measures, recently made an eight months' official tour of the United States for the purpose of observing the industrial developments in this country from a commercial and economic standpoint. His articles were contributed to the German weekly, Die Woche, under the general title, "The Land of Unbounded Possibilities," from which the following are extracts:

"The United States, like an enchanted garden, has brought forth from a marvelously productive soil splendid results of human ingenuity. Yet the thing that causes most wonder is that the concentrated intelligence which, intending to replace human factors by machinery, has, in working toward its aim, been giving to constantly growing numbers of workmen an opportunity to support themselves and become productive factors. The joy at the size of their own land encourages each individual. It makes him communicative and friendly to foreigners who are seeking information. It seems as though everyone were filled with the idea, 'The stranger shall see how great and strong America is.' My eight months' trip of observation and study took me through the States, and everywhere I found open doors inviting me to enter, and nowhere did I find the slightest attempt at secretiveness. Everywhere I observed an uncommon but steady bustle of men who enjoy their work and are consciously working for great results. 'It is a great country.' This is the verbatim designation of reverential admiration which the citizen of the United States has found for his country.

"The inhabitants of the United States, including Porto Rico, Hawaii and the Philippine Islands, number about 88 millions—that is, barely 5 per cent of the world's total inhabitants, according to its highest estimate. This 5 per cent has at present taken possession of 25 per cent of all the cultivated area of the earth, viz., 407.4 million acres out of 1629.3 million acres. A land of marvelous fertility offered itself for tillage, and the husbandman had but to gather in the produce. The virgin soil made his work easier, and its extensiveness rendered the application of artificial fertilizers practically unnecessary, although the agricultural offices of the States and the Union have constantly by excellent advice and practical expert assistance been furnishing the ways and means toward more intense cultivation.

"Let us examine the corn crops for the six years, 1895-1900. The world's total product fluctuated between 2.6 and 3 billion bushels per annum, a total of 16.6 billions for the period with an annual average of 2.77 billions. Of this amount the United States alone produced 12.4 billions, an average of 2.07 billion bushels per annum, or 75 per cent of the world's crop.

"Toward the world's wheat crop the United States contributed in the five years 1896-1900, 20.7 per cent, while for the year 1901 its contribution to the world's production of wheat amounted to 25 per cent. During the years 1896-1900 there were grown 14.7 billion bushels of oats in the world, and of this 3.74 billion bushels, or 25.5 per cent, were produced by the United States.

"In the production of iron ore the United States proved itself to be a veritable land of unbounded possibilities. It produced very nearly 36 per cent of the total iron ore produced, and that of the very best quality. In the past year the United States produced 39.3 per cent of the world's product of pig iron. In 1900 it produced roughly 10.1 million tons of steel, or 42 per cent of the world's product, and in the year 1901 the United States output was increased to 13.5 million tons.

"The United States produces nearly 55 per cent of all the world's copper. The development of the American copper industry was perhaps more rapid than typical for even American changes. From modest beginnings this industry grew by leaps and bounds in a remarkably short time to the most important factor in the world's production. In 1870 the copper production of the United States amounted to 12,000 tons; in 1880 its production had increased to 27,000 tons out of a total world production of 153,000 tons; in 1890 the United States produced 116,315 tons of the world's product of 269,455 tons. During 1895 it controlled more than one-half of the world's production, and at the end of the century the United States produced 270,000 tons, or more than the world's entire product had amounted to ten years before.

"The output of lead in the United States since 1895 has increased to such an extent that it has wrested from Spain the position of primacy in the world's production. In 1900 the United States produced 29.6 per cent, while Spain's share had receded to 18.7 per cent. In 1901 the United States increased its production of lead to 250,000 tons.

"The rivalry of the United States in the production of quicksilver has been equally strenuous. In 1900 for the first time Spain's product is slightly exceeded by that of the United States. In 1901 Spain's share in the world's product amounts to but 28 per cent, while the United States furnishes 33 per cent of the world's total product.

"The total world's production of gold for the year 1900 was estimated to be 255.6 million dollars; that of silver represented a coinage value of 223.5 million dollars. For the year 1901 estimates for both metals amount to 265 million dollars. In each of the two years the United States showed the greatest share of both metals, 31 per cent for gold and 33 per cent for silver."

Prof. Trowbridge's Experiments with Gases Subjected to Very High Temperatures.

In a communication to the Electrical Review, Prof. Trowbridge states that his study of gases produced by powerful discharges from condensers charged by a storage battery of from 10,000 to 20,000 cells, has now reached its limit. The glass vessels containing the gases volatilized under the effect of the discharges, and after one or two discharges cracked under the effect of the great heat. During the past summer he obtained in London suitable vessels made of quartz, which can be heated to a white heat without cracking, even if, while at this heat, they are plunged into cold water.

For this purpose Geissler tubes were made—four or five inches long—with a capillary portion of two inches in length.

In this capillary part the electric discharges produce the most intense light that has ever been studied, Prof. Trowbridge believes, in a laboratory. In its photographic effect it is at least four times that produced by the same amount of electrical energy discharged between magnesium terminals.

The result of Prof. Trowbridge's study of this light reveals the presence of both bright and dark lines in the ultra-violet portion in the spectrum of hydrogen or water vapor. The dark lines have never been seen before. They are due to a selective reversibility or selective solarization of the lines of the gas.

An American tender to install underground telephones in the city of St. Petersburg for 315,000 rubles has been accepted. The tender was on lower terms and easier conditions of payments than the offers of other bidders for the work.

Electrical Notes.

The Sheffield, England, electrical engineer, Mr. S. E. Fedden, gives some interesting figures relating to the use of steam turbines for electrical power generation in a paper read recently before the Municipal Electrical Association. From a table of actual tests of a 500-kilowatt turbo-alternator running at 2,500 revolutions per minute and with 140 pounds steam pressure at the stop valve, it appears that the consumption of steam per kilowatt hour at full load varied between 22.2 pounds to 28.9 pounds. The former consumption was obtained with a vacuum of 28 inches and the latter with 22 inches in the condenser. An economy of 8 per cent in steam consumption was obtained with 50 deg. superheat and 12 per cent with 100 deg. superheat.

Interesting experiments have been conducted by Dr. Lemstrom of Helsingfors University on the effect of an electrical discharge on the growth of plants. Four seeds of barley, wheat and rye were sown in pots, the soil being electrically connected with the ground. Above the two pots was suspended an insulated network of wire with a number of points of a Holz machine so connected that in some of the pots the electric current passed from the metal work to the earth, while in others it passed in the reverse direction. For five hours daily a current was passed through the soil. After eight weeks the height of the plants affected by the electric current was found to be about forty per cent greater than those to which no current had been applied. It is said that experiments with other plants show similar results, but different in degree.

The option held by the Continental Trust Company to purchase the common stock of the United Electric Light and Power Company and the stocks and bonds of the Mount Washington Electric Light and Power Company was exercised on November 15. The syndicate will secure power from the Susquehanna River. The introduction of electric power derived from the force of the Susquehanna River will have a vast influence on the manufactures of Baltimore. It is estimated that the cost of lighting the city can be reduced to about $20 per year per lamp, if the city maintains its own distributing plants. It now costs the city $99.12 for each arc lamp under a contract which expires in September, 1905. It is hoped that the industrial growth which accompanied the introduction of electric power at Niagara Falls will find a parallel at Baltimore. Plants of 50,000 gross horse power are planned.

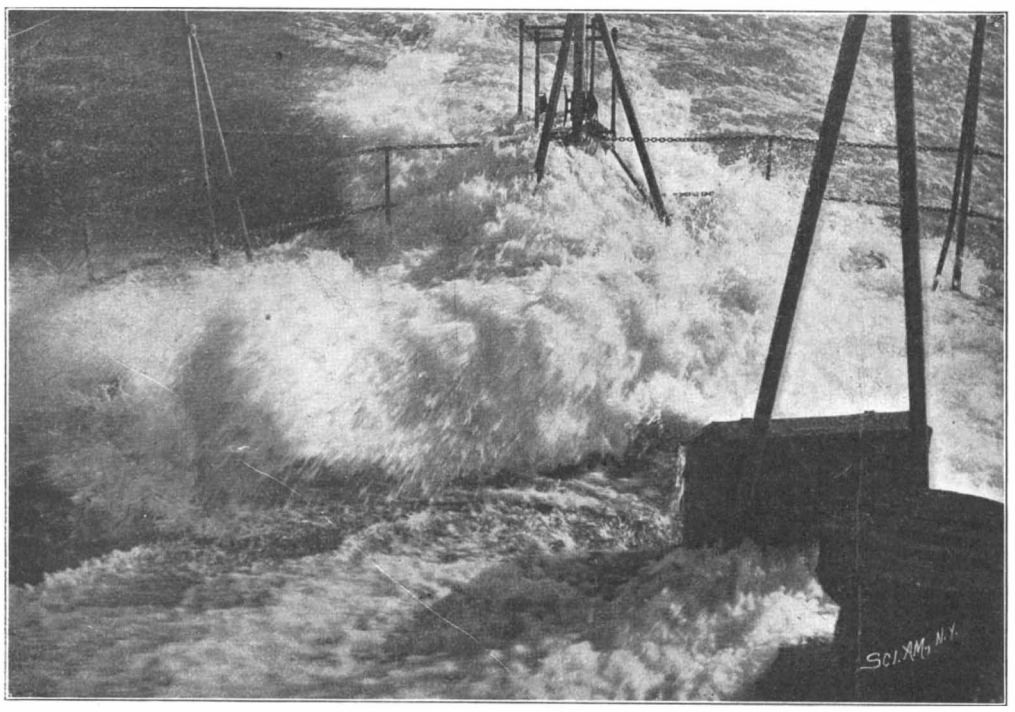
Rear-Admiral R. B. Bradford, Chief of the Naval Bureau of Equipment, has recommended to the Secretary of the Navy that the government secure control of all wireless telegraphic stations on the coast of the United States. Unless this is done, Admiral Bradford believes that there will be interference in the transmission of wireless messages between stations of private companies within the same circuit. Foreign governments are exercising careful supervision over the location of wireless stations for strategic reasons. Admiral Bradford in his report states that he had not been able to arrive at any satisfactory conclusion with the Marconi Wireless Telegraphy Company, for the reason that he can obtain instruments only on the payment of royalty. He states that most naval powers are far in advance of the United States in the installation of wireless telegraphic appliances on board naval ships, but he believes that no ground has been lost by reason of the slow progress made.

A new process for making incandescent lamp filaments has been invented by M. de Marc, of Brussels. His object is to form a core of magnesia upon which is deposited a layer of carbon, thus giving a filament which has a greater mechanical resistance than the ordinary carbon filament. To obtain the core, a mixture of magnesia, tar and powdered carbon is made and the pasty material is formed by high pressure into filaments or bands of the proper diameter. The filaments are then heated in a gas furnace at a high temperature in order to solidify them and produce a partial combustion. After coming from the furnace the filaments are very hard and resistant. They are then placed in a chamber in rarefied air or a gas containing oxygen and a weak current is sent through them in order to produce a combustion of the carbon and leave only the magnesia which forms the base of the core. In fact the carbon begins to burn at the exterior and the combustion proceeds toward the interior of the filament, while on the surface is formed a solid layer of magnesia. After this preliminary treatment they are burned in free air until all the carbon is consumed. In this way a small tube of pure magnesia is obtained, which is then to be coated with carbon to form the lamp filament. For this it is treated by a flash process like that of a carbon filament, in an atmosphere of hydrocarbon gas and the filament when raised to incandescence receives a deposit of carbon on the surface. Thus prepared, they are mounted in a bulb to form the lamp. The inventor claims that the lamps formed according to this process have a great mechanical resistance.

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THE NEW MONITOR "WYOMING."

The monitor "Wyoming," herewith illustrated, is one of the four monitors ordered by the government in 1898. The "Arkansas," "Nevada" and "Florida," now building in eastern yards, are identical. Their dimensions are, length on water line, 252 feet; extreme breadth, 50 feet; displacement on draft of 12 feet 6 inches, 3,218 tons. Watertight bulkheads, electric lighting and other conveniences for officers and crew are provided in as perfect detail as on ships of five times the tonnage.



TAKING IT OVER THE STERN AT 11.8 KNOTS.

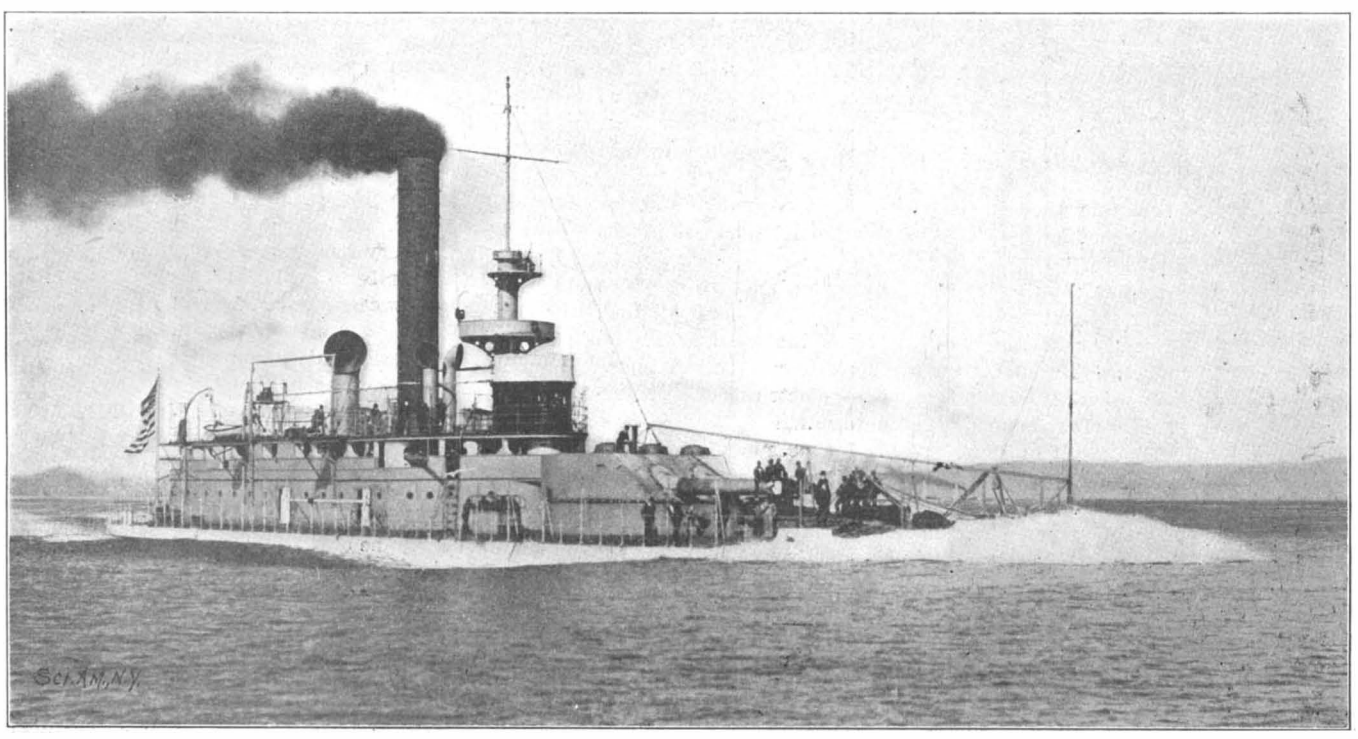
The armament of the "Wyoming" is heavy for a vessel of her size and class. It consists of two 12-inch breech-loading rifles, four 4-inch, three 6-pounders, six 1-pounders on the main deck with two of the same caliber in the fighting top. Forward is the armored turret protecting the 12-inch rifles. The hull is protected by steel armor, which for 108 feet amidships is 11 inches thick, diminishing to 5 inches at armor shelf, The belt extends from 2 feet 6 inches above the water to the same distance below, gradually tapering in thickness from 7 inches (just beyond the 11-inch belt) to 5 inches at both extremities. The engines are triple expansion, with cylinders 17, 26¼ and 40 inches respectively in diameter, with stroke of 24 inches. At 200 revolutions the engines develop 2,400 horse power.

There are four Babcock and Wilcox boilers with an aggregate heating surface of 8,800 feet and grate surface of 200 feet. A pressure of 250 pounds is developed at forced draft. Vessels of the "Wyoming" class are for purely defensive purposes.

The accompanying photographs, which are some of the most striking of their kind ever taken, were made on board the "Wyoming" when she was undergoing her trials, and they give a very impressive idea of the difficulties which a gunner on one of these monitors labors under when he endeavors to lay a 12-inch gun if the vessel is pitching or rolling in a heavy sea. Although the sea that was running on the occasion of her trials could not be called heavy for a vessel of the ordinary type, with a freeboard of say from 14 to 21 feet, it is evident that the monitor "Wyoming" made pretty rough work of it. At the bow there was a mass of broken water, and solid sea boiled up on deck, while spray was thrown high into the air. For the end-on position in which these vessels would prefer to do most of their fighting, there would be probabilities of poor marksmanship with showers of spray and broken water and the tops of the adjoining waves interfering very seriously with the gunner's aim. A heavy sea followed in the wake of the vessel, curling over and breaking inboard. Another feature that prevents good marksmanship on a monitor is the fact that her shallow depth and great beam render her very quick in her rolling and pitching movements. However, these monitors are intended for harbor defense, where the probability of heavy weather is somewhat remote. The pair of 12-inch guns which constitute their main armament are about the most powerful weapons of their class afloat. They are capable of penetrating nearly 20 inches of Krupp steel at a distance of 3,000 yards. Hence, as floating batteries co-operating with a system of land defenses, these vessels would find a limited sphere of usefulness; and it is not likely, under the present conditions of warfare, that they will ever be called upon for deep-sea work.



BOW OF THE "WYOMING" AT 11.8 KNOTS.



MONITOR "WYOMING" DOING 12.37 KNOTS ON THE MEASURED MILE.

Gas Arcs.

A number of years ago Denayrouze endeavored to obtain a higher flame temperature inside the mantle by blowing the required amount of air into the burner.

According to the Progressive Age, it was realized that the maximum temperature could not be obtained inside the mantle unless there was enough air thoroughly mixed with the gas to obtain complete combustion. The ordinary Bunsen burner did not and does not now draw in enough air for complete combustion and this makes it necessary to employ special devices when high efficiency is desired. The Bandsept construction has not been adopted in this country, but the Kern burner, which is a development along the same line, is now in satisfactory use among our gas consumers, and depends upon superior design and construction for its high efficiency, chimneys being dispensed with in the domestic installations. These burners seem to have gone as far as design alone in the injector and mixer construction can go. The Denayrouze idea of adding air under pressure possesses the disadvantage of requiring auxiliary apparatus which must also be maintained, thus limiting the field of application very much, although the English tests of the Suggs and Keith apparatus do not by any means point to failure.

In Germany there was another idea conceived, and the product put on the market during 1899 and 1900, which obtained the desired result by connecting the small globe surrounding the mantle to a tall chimney above it, which produced sufficient draft to suck the consumed gases rapidly through the mantle, and so much reduced the pressure inside it as to create an increased upward draft of air through the Bunsen tube. The quantity of gas passing through the jet depended upon its size and the gas pressure and was very little influenced by the increased suction in the Bunsen tube, so that the desired increase in the proportion of air was obtained, a high degree of temperature produced and the resulting incandescence far exceeded that of ordinary burners. This was further increased by permitting the gas to become heated before entering the burner.

This design is known as the Lucas lamp and to the inventor is due the credit of providing the gas industry with a means of displacing electric arc lamps, for our popular gas arcs are the outgrowth of the Lucas principle.

A Curious Accident.

A curious accident befell an electric street railroad car in the north of England recently during a thunderstorm. At the terminus a car was waiting to begin a journey, and several passengers had taken their seats both inside and on the outside of the car. There came a vivid flash of lightning, followed immediately by a terrific report on the car, and the whole interior of the vehicle seemed to be ablaze. When the flame had vanished the car was filled with smoke. The lightning had struck some trees, the branches of which overhung the stationary car so that they conducted the lightning current to the vehicle, and upon coming in contact with the current propelling the car, fused. Fortunately no damage was caused beyond the fusing, though the vehicle might have been set ablaze.

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GUATEMALA'S EARTHQUAKES.

BY THOMAS R. DAWLEY, JR.

Guatemala has been particularly disturbed by earthquakes during the present year. Just about the time the world was horrified with the news of the eruption of Mont Pelée and the wiping out of the city of St. Pierre with its thirty thousand inhabitants, and also that of Soufrière, which caused great destruction and loss of life on the adjacent island of St. Vincent, news came from the Central American republic that its second largest city, Quezaltenango, had been entirely destroyed by earthquakes; but this third terrible catastrophe was lost sight of in view of the harrowing details of those so much nearer to us in the West Indies, and available to the news gatherers. The available means of transit shut us off from that most interesting country which has been the center of seismic disturbances throughout the present year, and it is only after a lapse of time that we can obtain anything but the most meager reports of what has really happened.

Quezaltenango was a well-constructed city of imposing edifices of limestone, containing a population of upward of thirty thousand souls. It is supposed by some to have been built in the crater of an extinct volcano, but this is doubtful, the belief having originated from the fact that it is surrounded by high, jagged mountain peaks at an elevation of 8,000 feet above the sea. The earthquakes which destroyed it occurred last April, and shook the city from its very foundations, toppling the walls of the houses into the streets, killing and maiming many of its inhabitants.

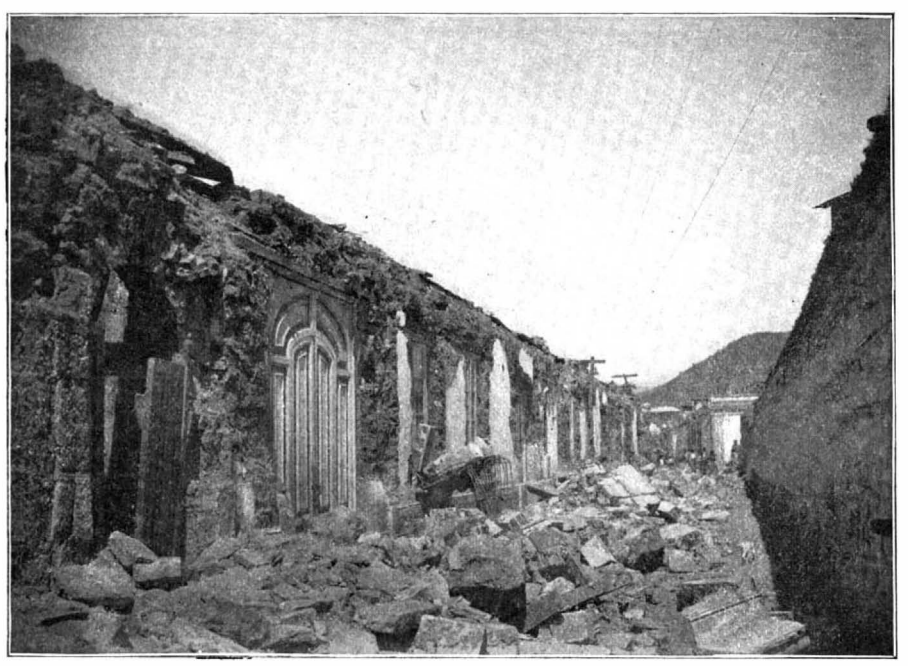
The major portion of the population of the city were Indians, but these are not Indians in our sense of the word, whom we most invariably picture as a wild, roving band of barbaric or semi-civilized people. The Indians of Guatemala maintained at the time of their conquest a civilization much superior to that of the Aztecs of Mexico, but they were lacking in both political and military organization sufficient to hold them together in any decided opposition to the small army of Spaniards under Alvarado, which Cortez sent against them, although they made on many occasions heroic resistance to their conquests. Though nominally conquered, many of them have preserved their ancient civilization and language intact to this day, the Nahuilas presenting the most striking example of this. These number about thirty thousand souls living in a gigantic caldron scooped out of the mountains, as it were, in the midst of the Cordillera, between the capital and Quezaltenango. They met Alvarado's army outside of their rocky basin and give it battle for an entire day, after which both they and the Spaniards appear to have been willing to treat for peace, and terms were agreed upon by which the Nahuilas promised to recognize the Spanish sovereign, the Spaniards on their part agreeing to leave the Indians alone in the future. And they have been pretty well left alone. They do not allow any stranger from the outside world to reside in their principal city, Santa Catalina, which is at the bottom of the bowl-like country, and they look with suspicion upon any one passing through their domain. They govern themselves, although the Guatemalan government pretends to exercise jurisdiction over them. They do not intermarry with any of the people surrounding them, and should one of their women fall a victim to the intrigues of an outsider, the offspring is sacrificed and the mother becomes an outcast. In former days, it is said that she was killed as well as the child. They allow no rum nor intoxicants of any kind sold within their jurisdiction; have no use for a jail, but flog those who are guilty of any crime known among them, such as a man and wife being unable to live together without quarreling, which is one of their most serious offenses. For these privileges of self-government they pay the government of the republic an annual tribute of $30,000

Guatemala has an estimated population of more than a million and a half people, and a climate so diversified that its people can find a home in any climate they choose, ranging from the tropic to the frigid zone. There are scattered hamlets on the coasts bathed in the burning rays of a tropical sun, where the land is so fertile it scarcely requires any effort on the part of the sparse population to produce their daily requirements. There are stretches of sandy plains, on the other hand, where it is necessary to turn the rivers from their beds to irrigate and produce, while higher up in the interior the traveler may find himself in a fairy-like town, built upon a shelving rock perhaps, where the people enjoy a climate of eternal spring. He may ascend to six thousand feet above the sea level in a day's journey, and find himself suddenly transported to a clime resembling some part of New England on a cold, raw November day. Thence he may travel across country over hills and dales, and suddenly find himself upon the edge of a mountain looking down upon a broad valley four thousand feet below him, in the center of which nestles a picturesque little city, which knows no change of seasons at all, but is bathed in the sunshine of an eternal summer.

At least one-third of the population of this country is pure Indian, with no voice in its politics or government whatever. And strange as it may seem, the bulk of this population is concentrated for the most part in the most inaccessible, inhospitable, rugged parts, where it would seem that livelihood for mankind is the most difficult of attainment. For this very reason these people are a rugged, frugal, abstemious lot, their tendency being to attend strictly to their own business and the teachings of their forefathers. From time immemorial they have combined with their chief industry of tilling the soil that of trade, Cortez having obtained from their so-called merchants, who appear to have traveled into Mexico to sell their products, his knowledge of the country before sending Alvarado to subjugate it. These same Indian merchants at the present day set out on long journeys from their native towns loaded with the products of their particular locality. These they carry in immense packs upon their backs held by a strap across their foreheads, and undoubtedly they penetrate regions unknown to them to barter and trade for such things that they are unable to produce at home. In the cold regions of Los Altos, there are tribes who dedicate themselves almost wholly to raising sheep and wheat, and they clothe themselves with garments of wool of their own manufacture. Each pueblo or tribe has a distinct garb of its own in color and fashion, while some of them have a distinct dress for their shepherds. When they have harvested a surplus of wool or wheat, they go forth, perhaps twenty or thirty of them in a band, with their great loads upon their backs, a long staff in one hand and a chief leading the way. They trot along in Indian file, descending the rugged heights, crossing



St. Nicholas Street, Where Several Women Were Killed.



Ruins of the Arena, Where the Bull-Fights Were Held.



St. Sebastian Street, After the Earthquake.



Remains of a House Belonging to a Wealthy Citizen, in Motazan Street.

A GUATEMALAN TOWN RUINED BY EARTHQUAKES.

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rivers and plains, frequently making twenty and thirty miles a day with a load of one hundred and twenty pounds on their backs, and after many days' journey return with equal loads of the produce of other countries and climes.

Sailing down the Pacific coast of Guatemala, the country presents one of the most beautiful sights imaginable. A line of volcanic peaks runs almost parallel with the coast from the frontier of Mexico to that of Salvador. The tablelands rise above the verdure-covered shore, and above these the mountain peaks, many of them capped with snow, and so perfect in form as to give the appearance of having been molded by some gigantic hand. There are some thirty of these peaks classified as volcanoes, and the terrible geological revolutions which have originated from them in times past can only be guessed by the present appearance of the country about them. In some places we find the conglomerations of enormous rocks as though thrown down by violent eruptions, in other places depressions of land where the mountains form colossal walls shutting in the drainage and forming great lakes, and in many places great cracks in the earth where it has been rent asunder and never healed.

But the people toil on, building their cities upon the shelving cliffs, planting their wheat and potatoes upon the very slopes of the most threatening volcano, and when the earth rumbles and shakes, the Indian merely looks up from his hoe, shrugs his shoulder, and if nothing more serious happens, he goes on with his work. An earthquake is nothing to him. If it swallows him up, perhaps then, so much the better. He does not seem to have any particular attachment for life. He is a sad, serious personage, who seldom laughs and never sings. He is entirely resigned to his fate, and seems to care little what that fate is to be.

But with that class of people known as the Ladino, the descendants of the old Spanish settlers, it is entirely different. At the very first mutterings of the earth, which seem to precede the usual earthquake, they are seeking places of safety in the open, and they usually begin to pray with all the vehemence there is in their souls. What is more, they fairly anticipate the earthquake, and are fleeing for their lives before the average foreigner, who is unaccustomed to the seismic disturbances, feels the slightest tremor, and often he stands in the greatest place of danger, wondering what the excitement is all about. My first earthquake occurring during the night, I slept soundly through it all, while other people were tumbling from their beds, falling over tables in the darkness and bruising their shins, in their efforts to get outdoors. The next morning they told me all about the frightful earthquake.

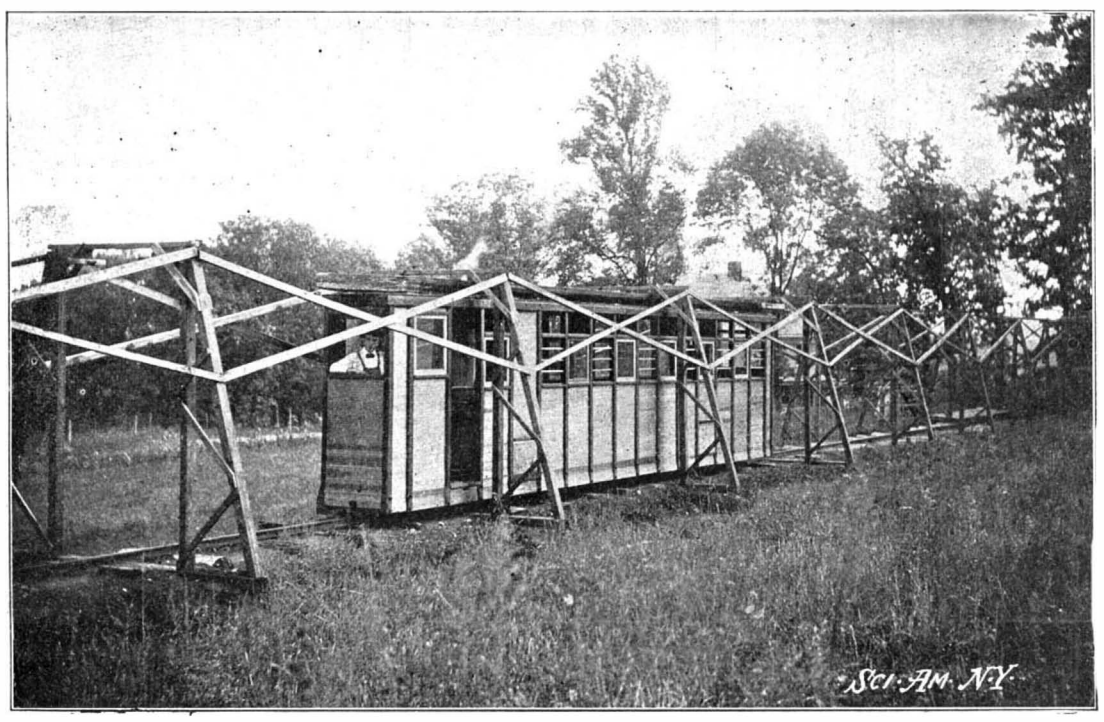
AN EXPERIMENTAL MONO-RAIL LINE.

BY DAY ALLEN WILLEY.

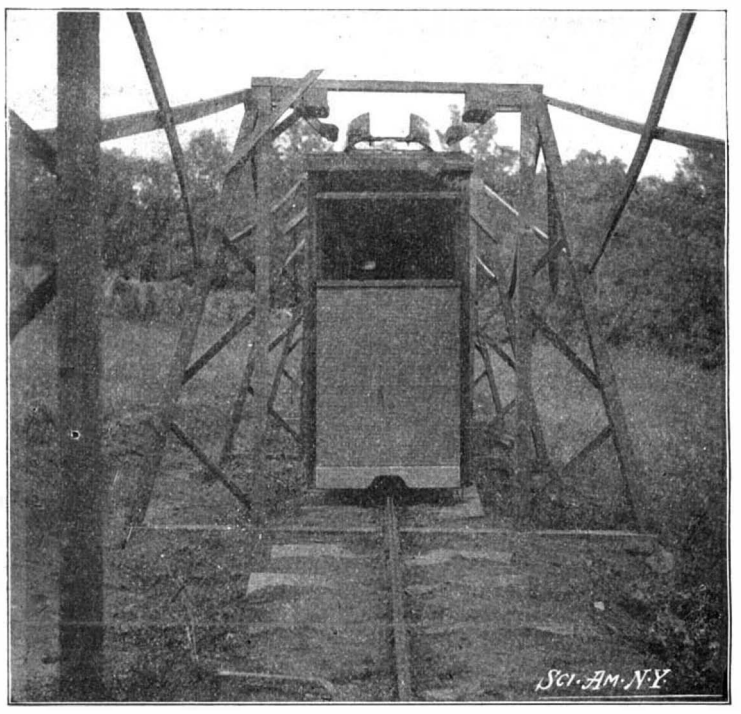
A railway in which the mono-rail system is utilized has been in operation for experimental purposes in the western suburbs of Baltimore for the last few months. It was constructed according to the design of Mr. Howard H. Tunis, who has secured patents on several features of the system which have never before been placed in operation. The track, although but 1,800 feet in length, has the general form of an ellipse, having a grade at several points of two per cent, as well as a number of 28-degree curves. The rail, which is laid in the center of the roadbed spiked to ordinary ties, weighs 30 pounds to the yard, and forms practically the only support to the two cars which are operated over the line, as the framework through which they pass is merely intended to maintain their equilibrium. The framework shown in the illustrations as a series of wooden arches is merely temporary, and will be replaced by steel in the permanent structure. Each archway supports a part of what might be called guiding pieces, which prevent the car from falling to one side.

The cars are large enough to hold 24 passengers. They contain their own motors, which utilize kerosene oil as fuel, steam being generated in an upright boiler and conveyed to a cylinder which moves a pair of sprocket wheels. The larger sprocket wheel, which is made especially heavy for the purpose, is joined to the axle of the forward truck wheel upon which the car moves, so that power is communicated to this wheel directly by means of a chain connection, and it may be termed the driving wheel. The car is supported upon this and the rear wheel only, the rims being grooved to the same depth as the wheels used on ordinary steam standard-gage railway cars. The arrangement of the engine is similar to that of some types employed in automobiles. Although it generates but four horse power, the empty car has been moved around the railroad in 2¼ minutes, or at the rate of 9 miles an hour, while with every seat occupied a rate of 8 miles an hour has been maintained without difficulty. In fact, the engine is so small that it seems almost like a toy. About ½ horse power is utilized in running the water and air pumps, so that actually only 3½ horse power is applied to the movement of the load. The car itself with the engine weighs 3 tons, and when filled with adult passengers weighs between 4 and 5 tons.

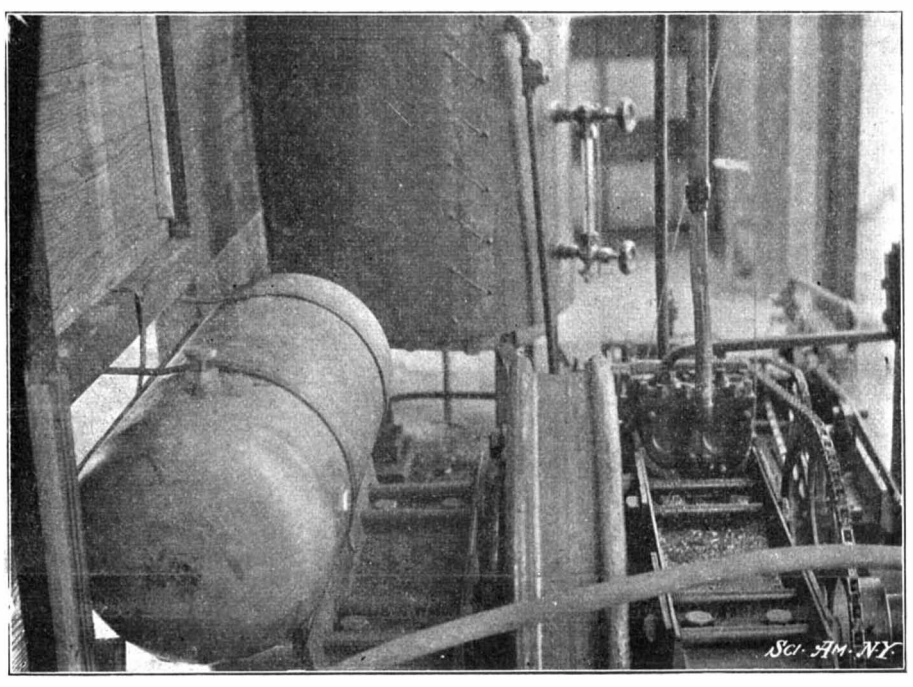
The device which keeps the car from toppling over when in motion is one of the features upon which the inventor has secured a patent. It consists of two strips of wood extending lengthwise along the roof of the car and a series of spring blocks on the archway framework. The strips are slightly curved at the ends, meeting in the form of a V, and as the car moves, they pass between the spring blocks fixed to the archway. The guiding strips and the spring blocks are greased to reduce friction, and the arrangement is such that at least two pairs of spring blocks are continually pressing against the guiding strips. This device prevents swaying even on the most abrupt curves and when running at maximum speed. Ball bearings are utilized to overcome friction in moving the driving wheel, and this is one of the important advantages claimed for the system. Another claim is that the amount of friction is greatly reduced by the use of the single rail, even though the guiding strips on the top are continually in contact with the overhead structure. The fact that a load aggregating nearly five tons can be hauled at the rate of speed mentioned by an engine of such power is also advanced as a claim for its efficiency. The rates of speed given are maintained even upon the highest grades and sharpest curves. A company has been formed to build a railroad 16 miles long in Virginia embodying Mr. Tunis' ideas.



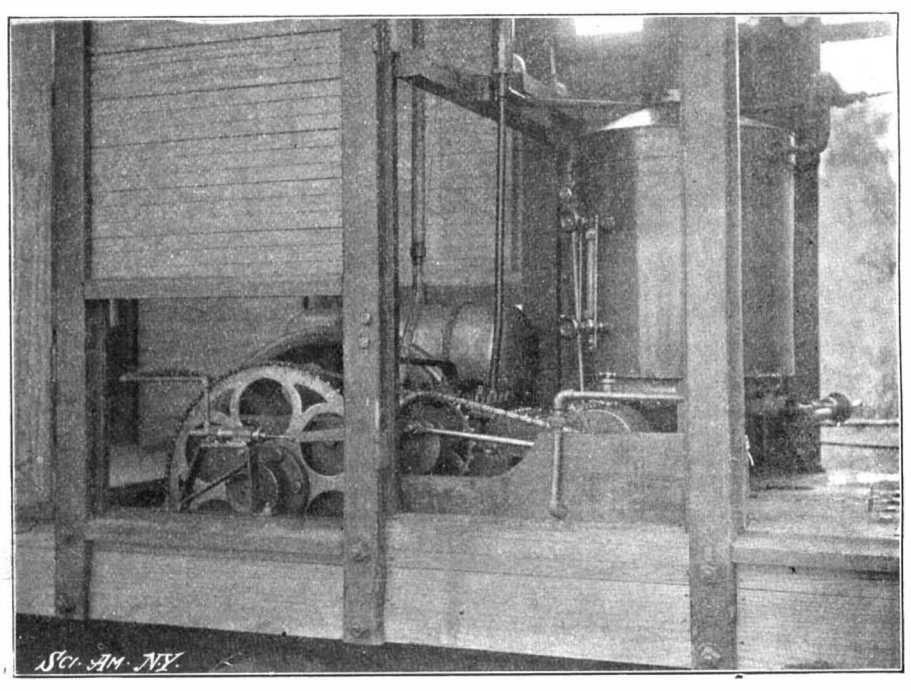
A NEW MONO-RAIL LINE—CAR VIEWED FROM THE FRONT.



REAR VIEW, SHOWING GUIDING STRIP AND SPRING BLOCKS.



VIEW OF ENGINE AND BOILER FROM THE REAR.



SIDE VIEW OF ENGINE, SHOWING CONNECTION WITH TRUCK WHEEL.

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RECENTLY PATENTED INVENTIONS.

Engineering Improvements.

ROTARY PUMP.—O. C. JONES, Philadelphia, Pa. This rotary pump is constructed to be easily reversed and is adapted particularly to be used in connection with an improved rotary engine invented by Mr. Jones, which was recently described in the SCIENTIFIC AMERICAN. The pump comprises a pump cylinder with inlet and outlet orifices, a rotary piston, a swinging abutment mounted in the cylinder, and a wall arranged at one side of the piston turning therewith. The wall is spaced from the adjacent head of the cylinder and is provided with orifices at the respective sides of the piston. A chamber is attached to the wall which communicates with one of the openings in the wall and also with the discharge or outlet orifice.

Hardware.

SOLDERING-IRON.—A. G. KAUFMAN, San Francisco, Cal. Mr. Kaufman's soldering-iron belongs to that class adapted to be heated by burning gas. The invention provides a tool arranged to allow convenient handling and manipulating by tinners, plumbers, and other mechanics, which will insure a uniform internal and external heating of the point without danger of impairment by external influences such as draft, dropping of solder and the like.

NUT-LOCK.—W. D. EVANS and J. C. WIGGINS, Eupora, Miss. A simple and positive nut lock which will not detract from the strength or appearance of the bolt and nut but will rather add thereto, has been invented by Messrs. Evans and Wiggins. The construction of the nut lock is such that it may be used with equally good results upon metal or upon wood. It may be expeditiously and conveniently applied and when once adjusted cannot be shaken loose.

Mechanical Devices.

MACHINE FOR BENDING PIPE-ELBOWS.—E. H. SMITH, Mt. Vernon, Ohio. In the operation of this machine the pipe will be fitted on a mandrel and held by clasps slipped on over the pipe. Jaws are then operated to compress the clasps and pipe and the proper treadle is operated to set a worm into gear with its worm wheel, which thereupon causes a bail to swing upward and tilt the mandrel, bending the pipe elbow, as desired. In thus bending the pipe elbow the preliminary crimps will be forced up between the sections of the clasp and will be pressed into the form of flat ribs or flanges projecting from the surface of the elbow.

DEVICE FOR OPERATING CONCENTRATING-TABLES.—A. W. JOHNSON, Aspen, Colo. Mr. Johnson's invention is in the nature of a mechanical appliance for imparting to the reciprocating tables of ore concentrators and like machines, their necessary shaking movement. The novel construction and arrangement of the various parts afford five or more modified movements of the shaking table. But little power is required for operating the device.

CARTRIDGE-SHELL LOADER.—E. L. WETZIG and G. W. REUST, Junction City, Kans. In this cartridge shell loader, powder and shot holders are employed also a charge receiver arranged to slide beneath them. A lever is provided which is so pivoted that it may swing in both vertical and horizontal planes and engage with this charge receiver. A wad plunger is mounted to reciprocate vertically and is suitably connected with the lever whereby it is forced down with the same in loading the cartridge shell.

COLLAR-BUTTON-VENDING APPARATUS.—M. F. PRICE, Iowa City, Iowa. Mr. Price's invention relates to a machine designed especially for vending collar buttons, and the machine is of such character that it is readily adaptable to coin-controlled operating devices, thus enabling the inventor to provide a coin-controlled collar-button-vending apparatus.

APPARATUS FOR AUTOMATICALLY LIGHTING OR EXTINGUISHING GAS LAMPS.—T. F. WESTENHOLZ, Hellerup, near Copenhagen, Denmark. The lighting and extinguishing of street gas lamps is ordinarily undertaken by lamplighters and entails a considerable expense. In order to overcome this expense the present invention is provided, whereby the lighting and extinguishing of gas lamps may be accomplished automatically at a predetermined hour. This is accomplished by connecting a clockwork with the gas cock, which opens or shuts the latter through the medium of intermediate gearing.

Railway Contrivances.

AIR-BRAKE SIGNALING AND RELEASING DEVICE.—F. H. DUKESMITH, Charlestown, W. Va. The invention provides a simple construction whereby to signal to the train crew whenever the brake is set from any cause whatever, and further to enable the crew to release the brakes while the train is moving. The invention comprises important details of construction.

GRAIN-CAR DOOR.—G. R. GRIGG, Coffeyville, Kans. This car door, though especially designed as a grain door, may be utilized also for other purposes. Its construction is applicable to any car and will be a fixture. It may be made to closely fit in between the jambs, having hinged extensions or wings at its sides to fit back of and against the jambs, enabling the door to be opened outwardly when the wings are folded back by the pressure of the grain or material against it.

Technology.

APPARATUS FOR FREEING AMMONIA FROM GAS LIQUOR.—H. A. ABENDROTH, Berlin, Germany. The present invention relates to improvements in that class of apparatus for the treatment of gas liquor which consists of a number of superimposed cells, in the uppermost of which the crude gas liquor enters to be brought into contact with steam passing upward from underneath. In this treatment the incoming crude liquor is heated to such a degree that some of the ammonia gas is driven off by causing the liquor to descend through the heated column, while at the base of the latter the liquor is mixed with milk of lime in order to liberate the fixed ammonia contained in the liquor and to cause it, together with the evolved steam, to ascend the column.

ART OF MANUFACTURING WHITE LEAD.—C. H. VICKERMAN, Philadelphia, Pa. Mr. Vickerman's invention relates to the manufacture of white lead by the so-called "Dutch" process and it consists in carbonating lead in the presence of fibers of the domestic sumac plant, the fibers being previously leached and thereby divested of coloring-matters, thus preventing discoloration of the white lead as formed.

Vehicles and Their Accessories.

TOE-CLIP.—F. J. and W. H. MCMONIES, Portland, Ore. The toe-clip which is adapted for use in connection with bicycle pedals, comprises a substantially U-shaped bridge-piece which may be secured to the pedal. A flexible strap piece is provided which may be secured to the bridge piece. Means are supplied for adjusting the strap piece to fit varying sizes of feet.

SEAT ATTACHMENT FOR BABY-CARRIAGES.—M. ELWERT, Lodi, Cal. Mr. Elwert's invention relates to seat attachments of buggies, go-carts and similar vehicles, though more particularly for baby carriages, whereby a nurse or other attendant may sit down no matter where the vehicle may be situated, the seat being of such structure as to be readily folded and concealed beneath the body of the vehicle.

Miscellaneous Inventions.

PIN.—A. A. MANNINGS, 188 Alexandra Road, Kilburn, London, England. The invention relates to an improvement in scarf or other pins and has for its object to insure the permanence of the engagement of the pin in the fabric of the article in which it is inserted. The pin is provided at the head with a pointed spur or barb oppositely directed to the point of the shank which is adapted to engage the fabric.

VIOLIN.—M. KRIWULKA and P. E. HOLMQUIST, Philadelphia, Pa. The object of this invention is to provide means for exerting strain or tension on the body of a violin so that the necessity for frequent tightening of the usual strings will not be apparent, and the instrument will not so readily lose its tension over night. The arrangement at the same time secures a more powerful, clear, and voluminous changeable resonance in tone.

CABLE-JOINT.—W. M. MURPHY, New York, N. Y. Means are provided in this invention for joining the lead casing of submarine or other electric cable. When a cable is spliced it is necessary to join the lead covering hermetically. This has heretofore been done by "whipping" a joint around it; but by means of the present invention Mr. Murphy is enabled to dispense with this process and effectually connect the covering.

BARREL-FILTER.—J. J. PRINDLE, Colorado City, Colo. This barrel filter is especially designed for the extraction of precious metals from ore by the "chlorination process," and the primary object of the invention is the provision of a durable and cheap construction which effectually retains sand or pulverized ore in the cask while the valuable solution is being forced to the bottom of the same so as to pass out through the outlet.

GLOVE AND NECKTIE HOLDER FOR BOXES.—J. L. REINER, New York, N. Y. A simple and economic device is provided by this invention which can be conveniently, quickly and durably applied to the bottom of a box and rigidly secured in an upright position in any order of arrangement desired or best adapted to the character of the articles to be held for display in any predetermined groupings.

SCREEN.—H. LE F. SANDERS, Jersey City, N. J. Certain novelties of construction are involved in this improved window screen which permit its ready adjustment to a window of any size. The screen, though readily adjustable to any window, when in place is perfectly rigid and is adapted to slide on strips on the window frames to raise or lower or otherwise dispose it as desired.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 3472.—For dealers in ready-made, adjustable, small frame buildings.

Small Steam Motors. F. G. Grove, Luray, Va.

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"U. S." Metal Polish. Indianapolis. Samples free.

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Dies, tools, models. Am. Hardware Co., Ottawa, Ill.

Inquiry No. 3475.—For manufacturers of dynamometers.

Coin operated machines. Willard, 284 Clarkson Street, Brooklyn.

Inquiry No. 3476.—For makers of steam turbines of 2 to 5 horse power.

Dies, stampings, specialties. L. B. Baker Mfg. Co., Racine, Wis.

Inquiry No. 3477.—For the manufacturer of the Baker power pressure blower.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 3478.—For manufacturers of thin sheet celluloid.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3479.—For manufacturers of gun barrel tubes.

Want you to read our Ad. on page 385. A Money-making Metalworking and Stamping plant for sale.

Inquiry No. 3480.—For parties to make small steel or malleable iron castings.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 3481.—For a hand machine for fringing or raveling old carpet.

Gear Cutting of every description accurately done The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

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Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

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The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

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We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 3486.—For dealers in wood used by pattern makers.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3487.—For manufacturers of automobile parts.

Gasoline Automobile Batteries. William Roche's "Autogas" used properly will carry vehicle twice as far as any other battery of same weight. William Roche, inventor and manufacturer, 42 Vesey Street, New York, N. Y., U. S. A.

Inquiry No. 3488.—For makers of fire alarm whistles.

To Ambitious Persons.

A prominent business man of New York City writes that he would like to come in touch immediately with a few well-recommended people who desire a higher education. This gentleman (whose name is withheld at his request) has at his disposal a limited number of Free Tuition Contracts in a well-known educational institution for home study. This school can teach you to become a Practical Engineer, Electrical Engineer, Electric Railway Engineer or Telegraph Engineer, Illustrator, Caricaturist Ad-writer, Journalist, Proof-reader, Bookkeeper, Stenographer. If you are awarded one of these Free Tuition Contracts, the only expense to you while you are studying will be the cost of instruction papers, postage, etc., this you can pay during the first four months. If you are ambitious to improve your station in life, we should strongly recommend that you write to this gentleman at once. Address W. L. B., P. O. Box 53 Madison Square, New York City. Be sure to mention Scientific American.

Inquiry No. 3489.—For a small air pump to be run by an electric motor.

Inquiry No. 3490.—For the makers of the "Naphey" acetylene gas burner.

Inquiry No. 3491.—For the makers of the Duplex motor.

Inquiry No. 3492.—For manufacturers of vending machines.

Inquiry No. 3493.—For parties to make small steel or malleable iron castings.

Inquiry No. 3494.—For manufacturers of dynamos operated by windmill power.

Inquiry No. 3495.—For manufacturers of sorghum mills, with attachment for cutting the bagasse as it leaves the mill,

Inquiry No. 3496.—For planting machines for setting and watering in one operation.

Inquiry No. 3497.—For a patented box or crate which can be taken apart and returned to consigner

Inquiry No. 3498.—For a machine for preparing cotton for felt mattresses.

Inquiry No. 3499.—For makers of brick-making machinery.

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Inquiry No. 3501.—For parties dealing in rhodium.

Inquiry No. 3502.—For an outfit for making half-tones.

Inquiry No. 3503.—For machinery for compressing refuse, sawdust or other light material into special blocks or forms, for use as fuel.

Inquiry No. 3504.—For manufacturers of revolving brushes similar to those in carpet sweepers.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(8755) L. Q. says: I wish to know the ingredients and proportions—in short, the recipe—for a solder for tin by using which it is not necessary to use acid or other preparation in order to stop small leaks in family tinware. A. The free-flowing solder used by the fakirs is composed of 1 part lead, 2 parts tin, 1 part bismuth. The solder wire is made by flowing the melted solder through small holes in the corner of a square sheet-iron ladle, at the same time drawing the ladle over a cold flat iron surface. A little practice will give you the necessary conditions for making the solder wire uniform in size.

(8756) W. M. S. wants a formula for figuring the horse power, bore and stroke, also speed of four-cycle gasoline engines, and uses 8 horse power, double-cylinder, 350 feet per minute marine type as example. A. The horse power of a four-cycle gasoline engine is the mean explosive pressure multiplied by the cylinder area and one-half the number of revolutions per minute and the stroke in feet. The product divided by 33,000 equals the horse power. The details of engine dimensions, atomizers and vaporizers are now in press in a book on "Gas, Gasoline and Oil Engines," by Hiscox, $2.50 by mail, enlarged edition.

(8757) F. W. L. asks: 1. What is the approximate resistance of a quantity of barley lying loosely in a box of insulating material one foot long by one square inch in cross section, where current is run from end to end? A. The electrical resistance of dry barley under any circumstances would be infinite. It would be an insulator as dry wood is. If the grains are moist, they would conduct to an extent depending on the degree of moisture. 2. How long will it take one ampere of current to decompose one quart of water? A. A coulomb of electricity will deposit 0.00010384 gramme of hydrogen. This is done each second the electricity flows. One quart of water weighs 946.4 grammes. Of this 1-9 is hydrogen, or 105.15 grammes. Divide 105.15 grammes by the number given for hydrogen, and you will have the number of seconds required for one ampere to decompose 1 quart of water.

(8758) J. S. W. asks: 1. How is starch extracted from Irish potatoes, also from the cassava plant? A. Potato starch is usually prepared by rasping the tuber into as fine a pulp as possible, and washing this in water. The milky liquid passes through sieves of increasing fineness until the fiber, etc., are removed. In a settling tank the sand or other heavy matter is separated from the starch and the latter is siphoned off from the top through holes in the sides of the tank. Centrifugal machines are sometimes used for separating the starch from the water. The crude starch is purified by washings and levigation, with passings through sieves and bolting cloth. The purified starch is at last dried in drying rooms. The general process of preparing cassava starch is the same, only the work is done more crudely and by hand. There is a much less proportion of starch than in the potato, and the fiber is more difficult to rasp fine. The sifting is more difficult. The starch is dried in the air under sheds. If the damp starch is heated in shallow pans with constant stirring, the grains burst and adhere together, forming irregular kernels, sold as tapioca. 2. Is there any way of converting a continuous current of electricity into an alternating one? A. Continuous currents are converted into alternating currents, or the reverse, by a rotary converter. The armature has two windings, one of which is motor and the other dynamo. The current in the first drives the armature, and the second winding delivers the current of the sort desired

(8759) G. K. B. says: We have many gas wells here. When the gas comes out it is very cold. Many offer explanations, but I am not satisfied, as I do not believe they are based on scientific principles. Wells are bored about 1,000 feet to gas. A. The gas comes cold from the wells which you describe because it expands from great pressure at a depth of 1,000 feet to atmospheric pressure at the surface of the earth. This is fully explained in Sloane's book on "Liquid Air."

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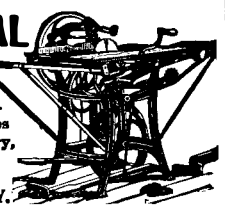
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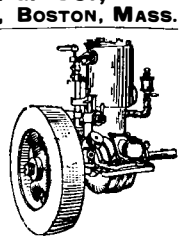
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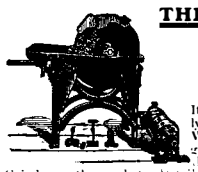
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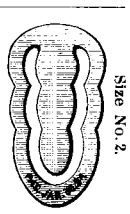


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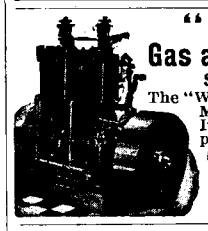
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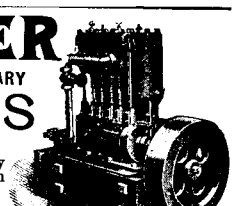
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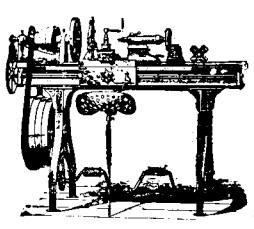
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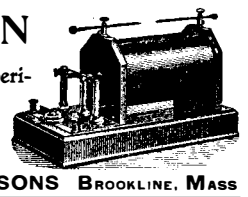
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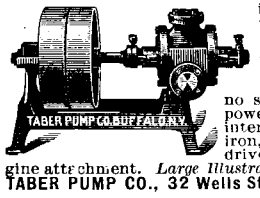
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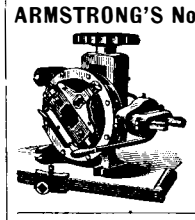
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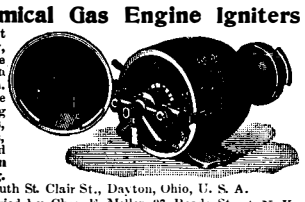
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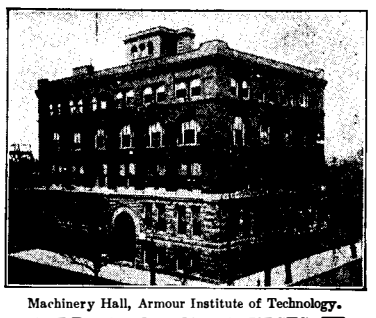
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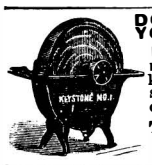
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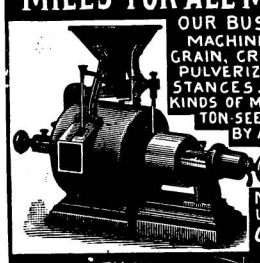
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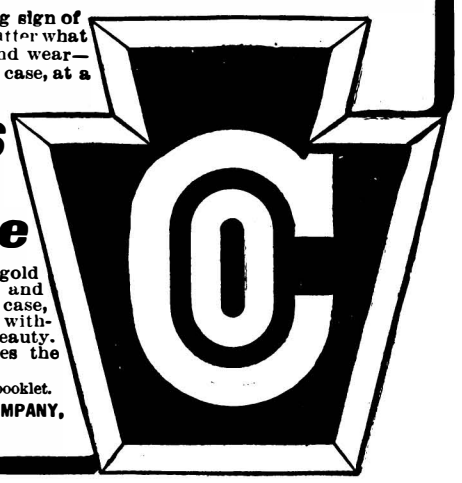
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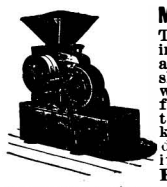
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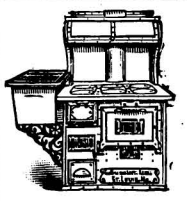
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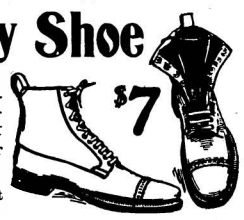


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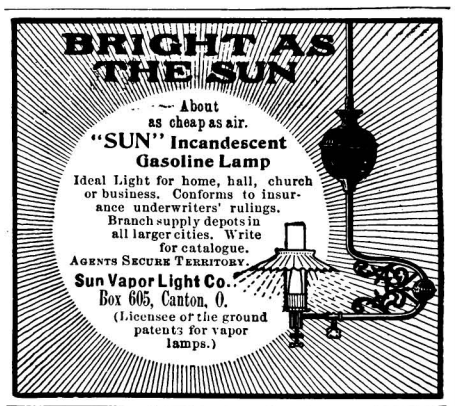


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DEVELOPMENT AND EVOLUTION. By James Mark Baldwin, New York: The Macmillan Company. London: Macmillan & Co., Ltd. 1902. 16mo. Pp. xvi, 395. Price, $2.60.

Professor Baldwin assures us in his preface that his work fulfills in a general way the intention expressed in "Social and Ethical Interpretations" of taking up some of the biological problems most closely connected with psychological ones and falling under the general scope of the genetic method. The theories outlined have been promulgated partly by Professor Baldwin and partly by Professor Osborne and Lloyd Morgan. The work thus becomes a kind of handbook of the theory of orthoplasy so far as the combined work of Professor Baldwin and other men are concerned. On the other hand, those portions which are due to Professor Baldwin alone contain expositions of "psychophysical evolution" and an outline of the "theory of genetic modes."

ARCHITECTURAL DRAWING. By R. Phené Spiers, F.S.A., Architect. Cassell & Co., Ltd., New York, London, Paris and Melbourne. 1892. 8vo. Pp. 67.

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THE BLAST FURNACE AS A POWER PRODUCER. Data relating to this and Allied Subjects. Edited by B. H. Thwaite, C. E., F. C. S., and Horace Allen, C. E. London, 1898. Pp. 36.

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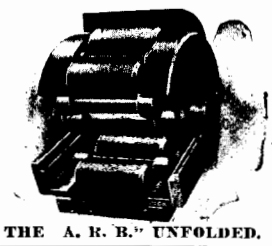
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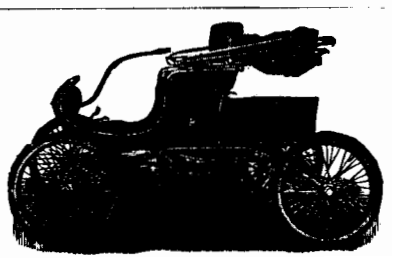
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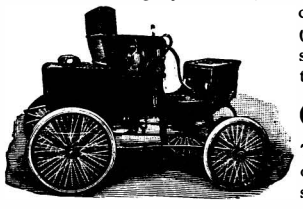
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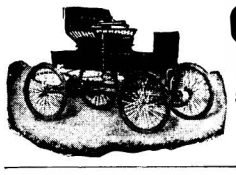
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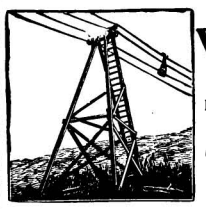


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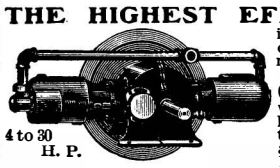
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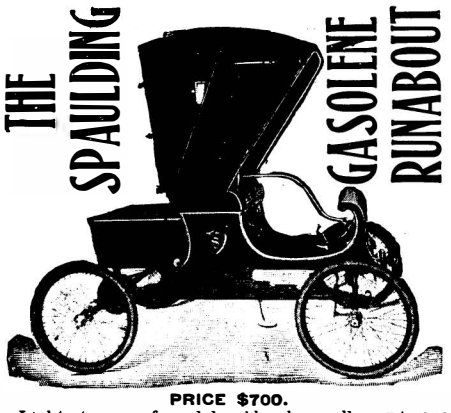
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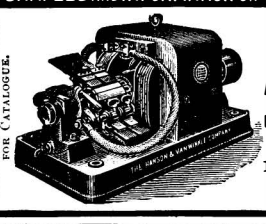


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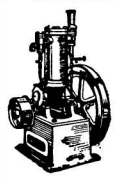
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